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THE WORK OF A LADDER DREDGE AND BELT CONVEYOR SYSTEM ON THE FOX RIVER, WISCONSIN.

By. L. M. Mann.*

For about 50 years the dredging on Fox River, Wisconsin, has been done by means of dipper and clam-shell dredges. Generally the spoil has been cast on or against the adjacent shores of the river, and about 25% of the material has to be dredged the second time and much of it the third time to remove it from the channel. Repeated dredging has formed high banks of spoil on either side of the river which are not only unsightly, but objectionable to property owners, and what is still more objectionable, are subject to erosion by action of the water, which necessitates repeated dredging.

The desire to obviate these objectionable features has resulted, after much study, in the development of what we have called the Conveyor Dredge. The writer proposed this name because the plant is practically a continuous belt conveyor, from the point of digging to the point of deposit.

The character of the land adjacent to the river prohibits the use of a hydraulic dredge which would deposit spoil in a semi-liquid state.

In the development of the Conveyor Dredge many questions had to be solved and many difficulties overcome, but although interesting, it is hardly necessary to narrate the various phases of development here. The writer's original idea was an elevator dredge with some sort of a conveyor attached. From this idea, the Bucyrus Company, of South Milwaukee, Wis., with the writer's advice, worked out the mechanical details, made the final plans and built the dredge, under contract, for the Government, for special work on Fox River, Wisconsin, under the direction of Major W. V. Judson, Corps of Engineers, U. S. A.

The main requirements to be fulfilled were:

1. A dredge to dig in all kinds of material except solid rock, or material equally hard.

2. To cut the full width of the projected channel without moving the dredge sideways.

3. Means to convey the spoil a considerable distance without rehandling.

4. To obtain the greatest possible area of distribution of the spoil and to deposit on either side of channel and in low places or sloughs.

5. To carry the spoil in places over old dredge banks not less than 20 ft. in height and also to distribute the spoil without forming high banks.

All the above conditions have been fulfilled in the Conveyor Dredge, a description of which follows:

The plant, as will be seen by the accompanying sketch and photographs, consists of a dredge with two intermediate and one delivery scow, which may be operated either en train or without the intermediate scows. The dredge is a regular elevator or chain bucket dredge, having a chain of 39 buckets of 5 cu. ft. capacity each, rolling over a steel ladder. These buckets are provided with steel teeth for cutting up clay and digging the hardest material, and may be set to dig at any desired depth, up to 10 ft. The dredge swings on a stern spud amidships, allowing it to dig on a circle of about 80 ft. radius, covering a width of channel of about 145 ft.

The material on leaving the elevator buckets, at the top of the ladder, is deposited in a hopper and passes thence onto a belt conveyor which conveys it aft over the stern of the dredge and delivers it into another hopper in the forward end of the intermediate or delivery scow. These several scows are provided with belt conveyors which keep the material in continuous motion until it is finally deposited where desired from the delivery scow, either on shore or in a dump scow. The conveyor on this scow projects by means of a steel ladder over the stern, a distance of 40 ft., and is hung from a gantry, permitting it to be raised to 20 ft. above water or adjusted to any lower elevation. The latter scow may be swung at any angle to permit the deposit of the spoil on either side of the river without disturbing the rest of the plant; or it may be attached directly to the dredge, and used without the intermediate conveyors, which at first seemed a difficult problem to solve. The complete plant carries the spoil 300 ft. from the point of digging, and this distance is limited only by the number and length of the conveyors used. The conveyors are of the Ridgway type, but are protected on the sides and bottom to prevent spilling; the belt is rubber, 32 ins. wide, and will easily convey the full delivery of the dredge.

The bucket chain of the dredge is driven by a 9 × 12-in. double reversing engine through gear-

THE CONVEYOR DREDGE AT WORK ON THE FOX RIVER, WISCONSIN, IMPROVEMENT.

Major W. V. Judson, Corps of Engineers, U. S. A., Engineer of District; L. M. Mann, U. S. A., Assistant Engineer in Charge. The Bucyrus Co., Contractors for Dredge.

*U. S. Assistant Engineer in local charge of Fox River Fox River Improvement, Oshkosh, Wis.

ing which also operates the ladder hoist drum. A six-drum winch, driven by a 6 × 6-in. double engine, is also provided for operating anchor, spud lines, etc. A walking spud, operated by a steam cylinder, is provided to move the dredge forward. The belt conveyors on the dredge and scows are operated by electric motors supplied by a 35-KW. electric generator on the dredge directly connected with a 10 × 10-in. engine, which also furnishes electric lights for the plant and power for operating a 6-in. spray pump for cleaning the belts. Steam is furnished by a Scotch marine boiler 9 ft. diameter, 10 ft. long, water back type, with two Adamson furnaces 35 ins. in diameter.

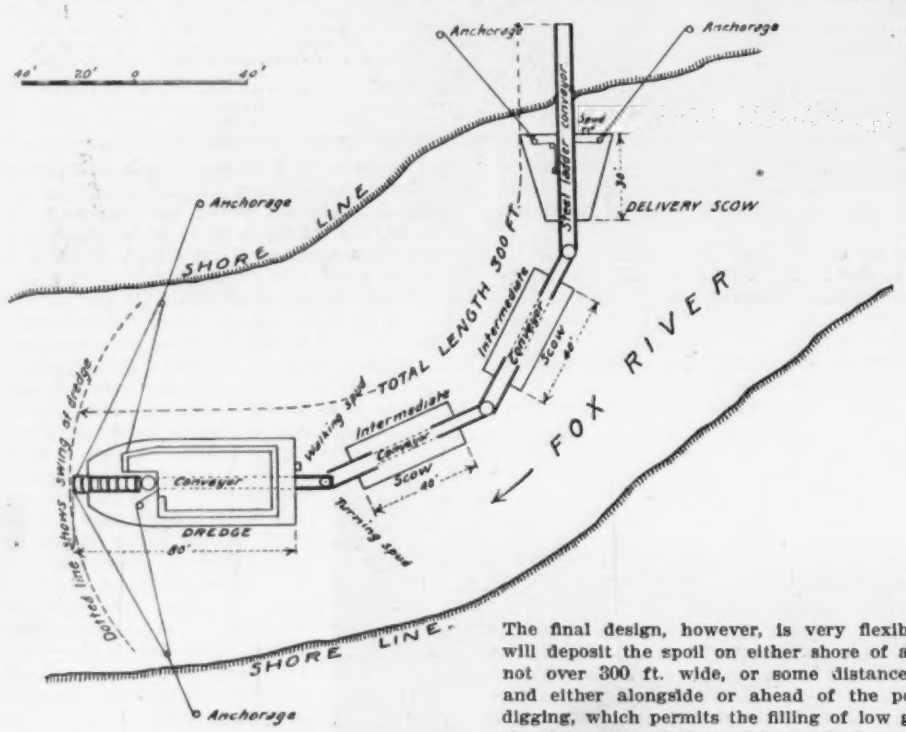


FIG. 1. SKETCH PLAN OF CONVEYER DREDGE PLANT.

The delivery scow is provided with a winch operated by an electric motor, for handling the anchor lines, gantry and spud.

Quarters for the crew are provided on the upper deck, and are unusually spacious, light and well ventilated.

delivery scow is nearly triangular in shape, being 31 ft. 4 ins. long, 16 ft. 4 ins. wide and 2 ft. deep at the forward or receiving end and 33 ft. 4 ins. wide and 4 ft. deep at the after delivery end. The hull is given this unusual shape the better to support the overhanging load of the delivery conveyor, and to secure a greater angle of gyration when the scow is attached to the dredge. The width of the hull was limited to allow it to pass the locks, which are only 35 ft. wide.

The first design made, had one conveyor 180 ft. long. This was very expensive and impracticable to work in harmony with the dredge; and on account of the insufficient space, the crew was to be quartered on a separate hull or house-boat.

The final design, however, is very flexible. It will deposit the spoil on either shore of a river, not over 300 ft. wide, or some distance back, and either alongside or ahead of the point of digging, which permits the filling of low ground, sloughs, etc., and the making of land.

The contract stipulated that the dredge should have a capacity of 250 cu. yds. per hour in ordinary digging. The first preliminary test demonstrated that she could dig 400 cu. yds. per hour; and she actually did dig 200 yds. in the toughest kind of clay and hard pan under adverse conditions. Although at times the buckets, when not full, carry considerable water, this flows back from the conveyors into the river and the spoil is deposited quite free from water. The crew of the plant now consists of 9 men, but can probably be reduced eventually. The cost of operation, including fuel, is about $30 per day,

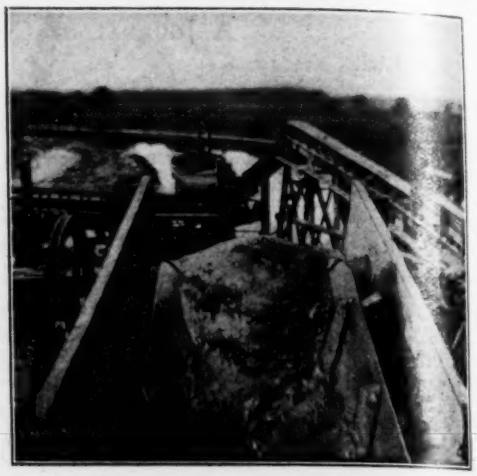


Fig. 3. Belt Conveyor Transporting Soft Sand.

but the plant will undoubtedly reduce the actual cost of dredging over the old dipper dredge 50% or more. The cost of wear and tear cannot be determined, of course, until the dredge has been operated about two seasons. The principal wear and cost, no doubt, will be the rubber conveyor belts; but this will be minimized by the comparatively small repairs to the machinery as compared with a dipper dredge.

The plant is a labor-saving device, and undoubtedly adaptable to many uses. Aside from its use as a river dredge, it might be used for removing bars in harbor entrances and depositing on either side of piers. It could be economically used in building levees or dykes when not too far removed from shore lines, obtaining the material from the river bottom and at the same time deepening the channel. It is adaptable for economically obtaining sand and gravel from pits, where water is available, or from the bottom of rivers or lakes and loading directly into cars or to be carried to a reduction plant. It is also adaptable in obtaining mineral deposits under water, delivering direct to reduction or concentration works.

One of the most difficult conditions in the operation of this plant is the varying load, due not only to the varying depths of water in front of the dredge or the varying face of the cut, but the character of the material. Each requires a different adjustment of the machinery, that is, a different speed of bucket chain and conveyors. This may vary in a single turn of the dredge, as sand, clay, hardpan, or a mixture of these each

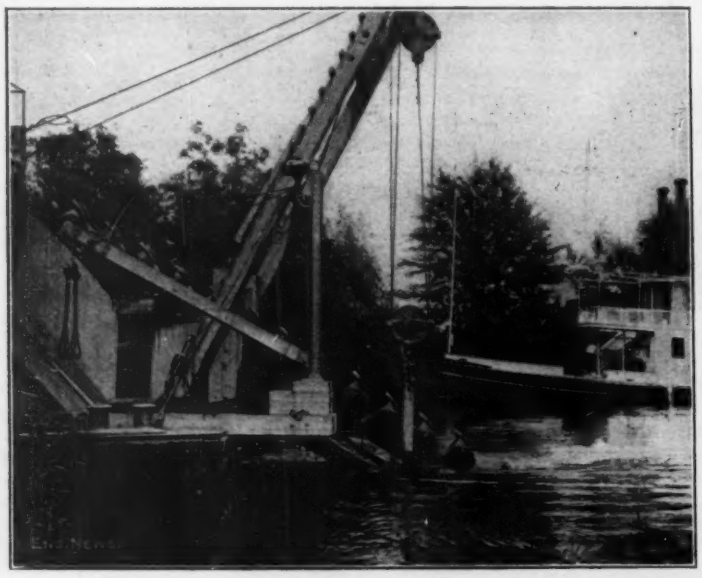


FIG. 2. BOW OF DREDGE, SHOWING BUCKET LADDER.

The hulls are built entirely of Oregon fir, the dredge hull being 75 ft. long, 31 ft. beam and 6 ft. depth of hold. The intermediate scows are 40 ft. long, 16 ft. wide and 3 ft. depth of hold, each carrying belt conveyors 65 ft. long. The

act very differently. When a uniform load of coal, gravel or sand is to be moved, the operation is much simplified.

A plant as above described, probably on a larger scale, might be applied in some places,

a few mechanics taking the places of hundreds of laborers and accomplishing better and quicker results. At the Panama Canal this might be the case, where the labor question is a very serious one. There is no reason why such a plant could not be placed on wheels and used for building highway and railway embankments, carrying the material from a cut out to a fill, where the distance is not too great.

For the successful construction of the plant, I wish to give particular credit to Mr. Walter Ferris, Assistant Chief Engineer of the Bucyrus Company, who directed the detailed mechanical designing of the plant, and also to Mr. A. B. Stetson, a former engineer of the company, under whose direction the work was commenced in 1902.

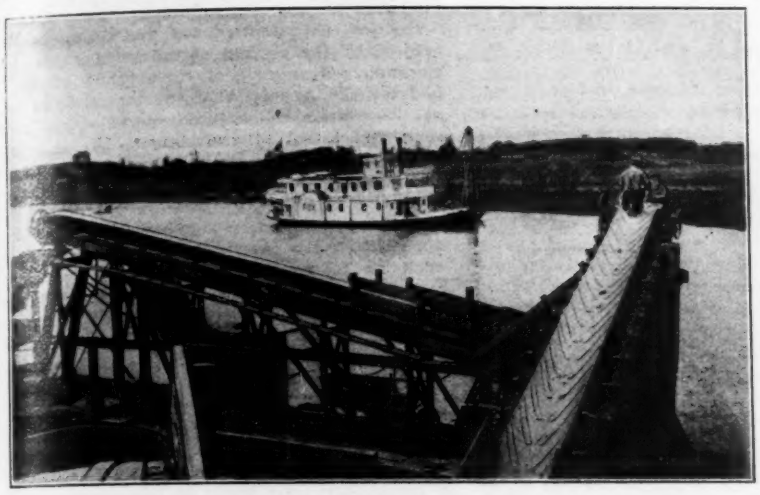


FIG. 4. BELT CONVEYOR ON INTERMEDIATE SCOW.

FIG. 5. END OF LADDER ON DELIVERY SCOW.

THE USE OF COPPER SULPHATE IN THE PURIFICATION OF WATER.

By Leo F. Rettger* and H. B. Endicott.*

Since the publications of Moore and Kellerman on the algicidal and germicidal action of copper in great dilution, the discussion which was begun by Nägeli over twenty-five years ago has taken a new start. Numerous investigations have been carried on in the past two years, and still the problem appears to be far from settled. The views regarding the copper treatment of algae in a large measure favor this method, and it must be admitted that for the temporary removal of algae from water supplies it has been employed with unquestioned success. But in regard to its application in the destruction of disease microorganisms, particularly the typhoid bacillus, views differ widely. It seems that writers either strongly uphold the method, making but few restrictions, or wholly denounce it as inefficacious and undesirable.

It is our belief that copper sulphate is a most valuable germicide in the purification of water supplies, but that its use as such must be limited rather than general, and must be determined by the conditions that prevail; such as temperature, relative amount of organic matter (particularly albuminous), and the size and condition of the reservoir, etc. Our opinion is based partly on the results of our own investigation.

The action of copper sulphate was studied on the following microorganisms: B. coli communis, B. typhi abdominalis, the bacillus of dysentery, the spirillum of Asiatic cholera, and the bacilli of fowl and of hog cholera. The first four mentioned are especially important, as they are intestinal bacteria in man. While the B. coli is not a disease microorganism, it is of significance in this connection, since it is always present in sewage-contaminated water and usually accompanies the typhoid and cholera organisms wherever they are found.

Below are tabulated the results of tests made with different waters and at varying temperatures. The reaction of the samples varied from neutral to slightly acid (to phenolphthaleïn). Ten cubic centimeter quantities of the water (sterilized) were inoculated with the bacteria in question and kept in test tubes. At the end of 24-hr. periods, sub-cultures were made in sterile bouillon, and evidence of continued growth was looked for.

A comparison of the two sets of figures in Table I. shows that the coli bacillus is slightly more resistant to the action of copper sulphate than is the typhoid bacillus. The different strains of B. typhi, also, gave more constant figures than B. coli. In every instance the typhoid germs were all killed in a dilution of 1 to 400,000, during an exposure of 24 hours at 20° C., while in two cases the colon bacilli were not all destroyed in the strength of 1 to 100,000. The above results were frequently duplicated, and control tests were made each time with constant results.

The effect of copper sulphate on the bacilli of typhoid fever, dysentery (Shiga), hog and fowl cholera, and the spirillum of Asiatic cholera is shown by Table II.

All the above organisms were very sensitive to the action of copper in dilute solution, and at the higher temperatures (31-33° C.) were killed off in dilutions of 1 to 500,000 and over. The other microorganisms are even more sensitive than the typhoid bacilli.

Table I.—Germicidal Action of Copper Sulphate on B. Coli Communis and B. Typhi Abdominalis.

Water from—	Temp., deg. C.	Thousands of parts water to 1 part copper sulphate. 1	10	100	200	400	500	Control
Effect on B. Coli Communis.								
Tap	20	—	—	—	+	+	+	+
Well (1)	"	—	—	+	+	+	+	+
Wagon	"	—	—	—	—	—	+	+
Well (2)	"	—	—	—	—	—	+	+
Well (3)	"	—	—	—	—	—	+	+
Well (4)	"	—	—	+	+	+	+	+
Lake Whitney	"	—	—	—	—	—	+	+
Well (5)	"	—	—	—	—	—	+	+
Snow	"	—	—	—	+	+	+	+
Well (3)	4	—	—	+	+	+	+	+
Well (1)	"	—	—	+	+	+	+	+
Well (2)	"	—	—	+	+	+	+	+
Wagon	"	—	—	+	+	+	+	+
Well (5)	2	—	—	+	+	+	+	+
Snow	"	—	—	+	+	+	+	+
Wagon	—4	—	—	+	+	+	+	+
Tap	"	—	—	+	+	+	+	+
Lake Whitney	—6	—	—	+	+	+	+	+
Tap	"	—	—	+	+	+	+	+
Well (4)	"	—	—	+	+	+	+	+
Effect on B. Typhi Abdominalis.								
Tap	20	—	—	—	—	—	+	+
Well (1)	"	—	—	—	—	—	+	+
Well (2)	"	—	—	—	—	—	+	+
Wagon	"	—	—	—	—	—	+	+
Well (3)	"	—	—	—	—	—	+	+
Well (5)	"	—	—	—	—	—	+	+
Well (4)	"	—	—	—	—	—	+	+
Lake Whitney	"	—	—	—	—	—	+	+
Snow	"	—	—	—	—	—	+	+
Well (1)	4	—	—	—	+	+	+	+
Well (2)	"	—	—	—	+	+	+	+
Well (3)	"	—	—	—	+	+	+	+
Wagon	"	—	—	—	+	+	+	+
Well (5)	2	—	—	+	+	+	+	+
Snow	"	—	—	+	+	+	+	+
Wagon	—4	—	—	+	+	+	+	+
Tap	"	—	—	+	+	+	+	+
Well (4)	—6	—	—	+	+	+	+	+
Tap	"	—	—	+	+	+	+	+
Lake Whitney	"	—	—	+	+	+	+	+

—Indicates no growth in the sub-cultures.
+ Indicates growth, or failure of the copper sulphate to kill all of the bacilli.

The toxic action of copper sulphate rapidly increases with rise of temperature, as the different tables clearly show.

Another important fact must be taken into consideration. In the presence of appreciable quantities of organic matter the efficacy of copper becomes greatly reduced, especially when albuminous substances are present. The copper forms more or less stable combinations with the organic matter, whereby it is precipitated and thus made innocuous. In a series of four tests with typhoid bacteria in water containing 0.01% of peptone, the temperature of the water being 20° C., the culture showed none of these bacilli in the samples treated with copper sulphate up to 1 part in 50,000; only one positive result was obtained with 1 part in 100,000, but all four of the 1 to 200,000 samples, as well as all four of the control samples, showed growths. The influence of larger quantities of peptone on the germicidal action of copper sulphate is shown by Table III.

In bouillon, therefore, which contains 1% peptone in solution, a concentration of copper sulphate of 1 to 10,000 is required to kill all the coli and typhoid germs, at 20° C. and above. The organic matter reduced the toxic action of the copper to one-fortieth of what it was in water alone.

A few experiments were made to determine the rate at which bacteria were destroyed in copper-

Table II.—Germicidal Action of Copper Sulphate on Various Bacilli.

Bacteria—	Temp., deg. C.	Thousands of parts water to 1 part copper sulphate. 50	100	200	400	500	1000	Control
Typhi	32	—	—	—	—	—	+	+
Asiatic cholera	31	—	—	—	—	—	—	+
Hog cholera	"	—	—	—	—	—	—	+
Chicken cholera	33	—	—	—	—	—	—	+
Dysentery	"	—	—	—	—	—	—	+
Typhi	20	—	—	—	—	+	+	+
Asiatic cholera	"	—	—	—	—	—	—	+
Hog cholera	"	—	—	—	—	—	+	+
Chicken cholera	"	—	—	—	—	—	—	+
Dysentery	"	—	—	—	—	—	—	+
Asiatic cholera	8	+	+	+	+	+	+	+
Dysentery	10	—	+	+	+	+	+	+
Hog cholera	3	—	+	+	+	+	+	+
Chicken cholera	"	—	+	+	+	+	+	+
Typhi	2	—	+	+	+	+	+	+

Table III.—Illustrating the Effect of Organic Matter (Nutrient bouillon 1% peptone) on the Germicidal Action of Copper Sulphate.

Bacteria.	Temp., deg. C.	Copper Sulphate. 1:1000	1:10000	1:100000
Coli	34	—	+	+
Typhi	"	—	+	+
Coli	20	—	+	+
Typhi	"	—	+	+
Coli	0	+	+	+
Typhi	"	+	+	+

Parallel tests with tap water gave negative results in every case.

Table IV.—Effect of Time on Typhoid Bacilli in Water at 20° C., Containing 1 Part per 100,000 of Copper Sulphate. (Numbers of B. typhi before and after inoculation.)

Before Inoculation.	Hours After Inoculation— 1	2	4
176,000	90,000	64,000	70
"	100,500	71,000	80
Before Inoculation.	**Hours After Inoculation—** **1**		**3**
74,400	34,500		285
"	35,500		305

All the tests were repeated at 6, 8, 24 and 32 hrs., but with negative results.

*Sheffield Scientific School of Yale University, New Haven, Conn.

containing water. Two sets of gelatin plates were poured with typhoid bacilli which had been removed at regular intervals with a graduate pipette from water containing copper sulphate in the strength of 1 to 100,000. In both sets of plates all the bacilli were rapidly reduced in numbers, so that after five to six hours of exposure to the copper sterile plates were obtained, as shown by Table IV., which gives the results of duplicate tests.

SUMMARY.

In the absence of appreciable quantities of organic matter (and an unusual amount of carbonates) and when the temperature is not too low (8-10° C.), copper sulphate has a strong germicidal action on B. coli, B. typhi, the organisms of dysentery and Asiatic cholera, and on hog and fowl cholera bacilli. At 20° C. they are destroyed in dilutions of 1 to 400,000 and over, within a period of 24 hours. In the natural condition of water in reservoirs, etc., the action is in all probability much greater. When used intelligently, therefore, copper sulphate is a most valuable agent in the purification of drinking water. It has been shown frequently that small quantities of copper have no injurious action on man. Certain fish may be injured by it, but only in concentrations much greater than those which are necessary to destroy the typhoid organism, etc.

Whether it is advisable to apply this method regularly to large reservoirs or lakes, especially when the volume of water cannot be computed, is a question. But for the purification of water in smaller reservoirs and in wells which are temporarily under suspicion, the method should prove to be a most valuable one. At any event, it appears to us that copper sulphate is the most efficacious and desirable chemical agent yet employed for such purposes. Costing only 5 or 6 cts. per lb., it ought to be within reach of almost everyone. In the hands of competent men it ought to be an important agent in the purification of wells suspected of typhoid, dysentery and cholera infection, and particularly in localities in which wells are the only or chief source of drinking water, as in our rural districts, India and the Philippine Islands. In British India permanganate of potassium has for several years been used to this end.

THE DESIGN OF CONTINUOUS BEAMS IN REINFORCED CONCRETE.

By John Stephen Sewell.*

As reinforced concrete becomes monolithic in setting, a series of contiguous spans almost necessarily forms a continuous girder. If reverse reinforcement is not used over the supports, cracks are very likely to occur at these points. Joints may be left, if it is simply a series of beams, or of floor slabs; but if the construction consists of beams combined with floor slabs, and especially if the supports are columns continuous above the beams, it is not so easy to leave joints, and there are objections to them, in any case.

It would seem that, to secure the best results, the principle of continuity should be accepted, and the design made accordingly. It is not usually impracticable to secure practically unyielding supports, and when this condition can be realized, there is no objection to the use of continuous girders, since the plastic material adapts itself to inequalities, and a nice adjustment of level in the tops of the supports is not necessary. There are many advantages in continuity of structure, and, in the case of reinforced concrete, at least, they undoubtedly outweigh its disadvantages.

It is not necessary to apply the theorem of three moments—in fact, this would be entirely wrong in most cases, because the intermediate support usually is of such nature as to resist rotation, and because the conditions of loading are sure to vary, so that the assumptions made in designing would hardly ever be realized in practice. The question is really reduced to the consideration of each span separately, as a beam more or less constrained at the ends. The continuity of reinforced concrete structures is recognized in building laws, which frequently authorize the use of a reduced moment at the center of the span, provided reverse reinforcement is used over the supports. The point of practical importance is the determination of the moments which shall be used at the center, and over the supports.

Let l be the length of the span, in feet.

Let w be the uniformly distributed load, per lineal foot.

Let M be the bending moment at the center, in foot-pounds.

Let M′ be the bending moment over the supports, in foot-pounds.

If the beam be freely supported,

$$M = wl^2/8 \quad \ldots\ldots (1).$$

If the beam be completely fixed at the ends,

$$M = wl^2/24 \quad \ldots\ldots (2),$$

and

$$M' = wl^2/12 \quad \ldots\ldots (3).$$

If the beam is only partially fixed, the value of M will be greater, and that of M′ less, than those that would result from equations (2) and (3). Their sum, in any case, under uniform loads, is equal to $wl^2/8$.

It is common practice to permit the use of the formula,

$$M = wl^2/10 \quad \ldots\ldots (4).$$

In this case, rigidly speaking,

$$M' = wl^2/40 \quad \ldots\ldots (5).$$

In actual designing, however, it is customary to assume a higher value for M′, such, for example as would result from

$$M' = wl^2/20 \quad \ldots\ldots (6).$$

If an interior span of the girder is fully loaded, and the adjacent spans on either side are entirely without load, the loaded span, in most cases in practice, will be only partially fixed at the ends, and it is undoubtedly necessary to design it for a value of M greater than $wl^2/24$. It is entirely possible, however, by proper loading of the two adjacent spans, to put the central span into the condition of a girder completely fixed. In this case, the reverse reinforcement should certainly not be designed for a less value of M′ than with $wl^2/12$.

If loads concentrated at the center are considered, the values of M and M′ are equal to each other, in a completely fixed beam. If it be assumed that an average uniform load is the proper basis for design, and that a central concentrated load shall always be limited to a value which will produce moments not in excess of those produced by the uniform load for which the beam was designed, then a value for M′ of $wl^2/12$ will adequately meet all probable conditions of loading. Unless the live load is very much larger than the dead load—in fact, in practically all ordinary structures—a value of $wl^2/12$ for M will also meet all requirements for the design of the section at the center of the span. For the last two years the writer has used this value of $wl^2/12$ for both M and M′ in most of his own work, and he is convinced that it is safer than the use of the values $wl^2/10$ and $wl^2/20$ (which seem to be more often used than any others), besides being somewhat more economical.

Under uniform loads, the points of contraflexure of a completely fixed beam are distant 0.2113 l from the ends of the span. Under a central concentrated load, they are distant .25 l from the ends of the span. To meet all conditions, the reverse reinforcement should therefore extend into the span a distance of .25 l from each support.

It will be found that a beam designed for $M = M' = wl^2/12$ will take exactly the same amount of steel as if it were designed as a freely supported beam, for $M = wl^2/8$; but the beam itself will be lighter and less costly, and nearly all practical structures safer, than if it were designed as freely supported and without reverse reinforcement.

The writer's attention was first drawn to this subject by the method of failure of a partially continuous floor slab, of three spans, which he had tested. A portion of the central span was cut loose from the adjacent parts of the same span and tested to destruction. The slab was reinforced over the supports on a basis of M′ = $wl^2/24$, or thereabouts. The upper part, just over the edges of the supports, cracked and opened up long before any serious damage was apparent at the center, yet the conditions were such as to permit of considerable movement over the supports. There was evidence of some adjustment at these points, but it was not enough to save the slab from damage under loads which, while greater than safe working loads, ought to have been carried without serious injury to the slab itself.

It would seem that, if any degree of continuity exists, every span ought to be so reinforced against reverse strains that it can act as a completely fixed beam, if necessary. At the same time, the central section should be designed to be safe under a degree of fixedness much less than this.

The logical conclusion seems to be that reinforced concrete should always be made continuous—not partially, but completely so; and that it is not safe to count upon inadequate reverse reinforcement at all, since its only effect may be to cause cracks which would otherwise open up over the supports, to appear at some point in the clear span, where their formation constitutes a serious menace.

If the above reasoning is correct, there is no safe middle ground between a series of spans freely supported, and a series in which each span is so reinforced as to enable it to act as a completely fixed beam, if necessary. At the same time, it should be so designed that the middle section would not be overstrained under any probable condition of partial fixedness. It seems to the writer that values of $M = M' = wl^2/12$ would, in most cases, cover the ground; and that to design for $M = wl^2/10$ and $M' = wl^2/40$ or $wl^2/20$ is not only inadvisable but actually bad practice. The writer was recently called upon to give expert testimony in a suit for infringement of patent in which the principles of continuous—or at least constrained—beams, were of importance. He stated the proposition contained in the first sentence of this paragraph. A very eminent engineer, retained by the other side, stated that this proposition was fundamentally erroneous. This caused the writer to very carefully review the whole matter; as further study only leads him the more forcibly to the same conclusion as before, it is herewith submitted, in the hope that a discussion may result which will finally determine it.

VIEW OF SANTA CATALINA DAM NEAR DURANGO, MEX., AFTER HAVING BEEN OVERTOPPED BY 30 CM. OF WATER.

*Captain, Corps of Engrs., U. S. A., P. O. Box 455, Washington, D. C.

THE FAILURE OF THE SANTA CATALINA DAM NEAR DURANGO, MEX.

Through the kindness of Mr. James D. Schuyler, M. Am. Soc. C. E., of Los Angeles, Cal., we are able to present a view and a few statements regarding the failure of a masonry dam near Durango, Mex.

It appears from the view shown herewith and the meager information at hand, that the dam was of light gravity section, provided with an independent spillway and not intended to be overtopped. It also appears, but is not certain, that the body of the dam was composed of rubble embedded in concrete, and that it was faced with concrete. The photograph we produce had two or three sentences typewritten upon it in Spanish, which in English read substantially as follows: "The height of the dam was 15 m. [49.2 ft.] up to the wasteway. It was overtopped by a sheet of water 30 cm. [0.984 ft.] deep." The wasteway was about 50 ft. long. The dam cost $63,000.

The reservoir supplied water for irrigation and was located on the Hacienda de Santa Catalina del Alamo y Anexas, which is the property of Senor Pablo Martinez del Rio. The failure occurred after heavy rains. The manager of the hacienda, seeing that the dam was being or was about to be overtopped, gave warning to the people below, so that although several houses were swept away only one life was lost. A considerable damage was done to crops.

A DEVICE FOR REGULATING THE DISCHARGE OF WATER FROM A RESERVOIR.*

By P. Bouéry.†

This account of a contrivance which has been found serviceable in practice may be of interest to engineers, and especially to those engaged in hydraulic mining.

In that process one feature which seems at first sight to possess little significance is highly important in its effects, namely, the regular supply of water to the "giants." The chief condition of this regularity is an even flow in the pipe line from the penstock to the nozzle. This, of course, requires that the penstock be kept full. Any considerable surplus of water overflowing at the penstock is a simple waste unless it be otherwise utilized in the sluices. At all events, it does not affect the delivery of the nozzles. But a deficiency at the penstock may admit air into the pipe, and this may produce hydraulic recoil, injuring the line by incessant vibrations, giving rise to leaks and even to blow-outs and (when a partial vacuum exists at the time of the fracture) the collapse of the pipe.

An accident of this sort in our main pipe line, occasioned partly by a settling of the ground and partly by the presence of air in the pipe, led to the employment of the device here described. The line referred to is made of 30-in. pipe, successively reduced to 18 and 15 ins. in diameter for the supply of two giants. By reason of the causes just mentioned the 30-in. pipe burst more than 1,400 ft. from the penstock, and despite the air valve the 30-in. pipe was collapsed to such a degree that one length of it, next to the penstock, was squeezed together and positively swallowed by the main pipe, through which it traveled for 750 ft., piercing through a short elbow on the way.

This remarkable result was undoubtedly the effect of the vacuum suddenly produced when the pipe burst.

Aside from the dilatation and contraction due to changes in temperature and changes in the ground itself (all of which, except earthquakes, should be prevented by suitable care in construction), a pipe line, properly laid, is exposed to no other cause of injury than the action of air mixed with the water, which, by reason of the difference of the two in specific gravity, produces variable and unequal strains in the pipe.

At every hydraulic mine a reservoir is interposed, if practicable, between the ditch and the pipe line to the giants for the storage and proper utilization of the water. When this reservoir is full and the giants are ready to be operated the gate tender opens the main gate of the reservoir just enough to supply the giants and give a little overflow at the penstock to prevent the entry of air. If the supply to the reservoir is smaller than the discharge thus permitted, the consequent lowering of the water level in the reservoir reduces the hydrostatic pressure at the discharge opening, and therefore the rate of discharge. To counteract this effect the gate tender raises the gate so as to compensate by greater area the diminished pressure, and this process is continued until the reservoir is almost empty.

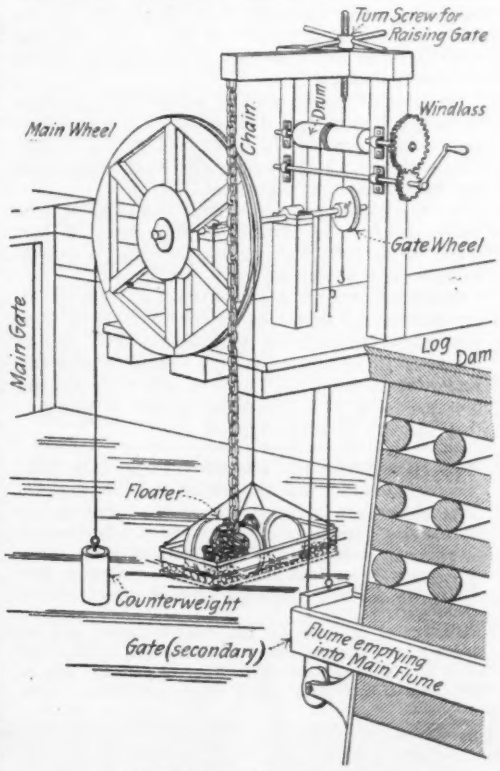
This method of regulating the supply of water to the giants evidently leaves the whole matter to the vigilance and skill of one man, who, however faithful in the main, cannot be expected to prevent, or even to be able to prevent, irregularities in the working supply. If he raises the gate either a little too high or a little too late, the result is in one case an unnecessary loss of precious water through excessive overflow, or, in the other case, the entrance of air into the pipe line, with consequent injurious vibrations.

We have found that this source of irregularity can be removed, while, at the same time, the wages of one man for both the day and the night shift could be saved by utilizing the water in the reservoir itself to furnish a hydraulic head sufficient to operate automatically and continuously a little auxiliary gate (independent of the main gate), and thus maintain the small overflow at the penstock needed to prevent the entrance of air. The device adopted for this purpose is shown in the accompanying figure. This sketch is not drawn to scale, but it will sufficiently illustrate the following description:

(1) In the dam of the reservoir we cut a second outlet of appropriate size at the level of the main gate.

(2) On the top of the dam we set up a large wheel with grooves for two small cables, wound in opposition and supporting, respectively, a floater and a counterweight.

(3) On the prolongation of the shaft of the main wheel we fixed a smaller "gate wheel," of relative diameter, duly calculated, carrying a cable attached at its lower end to a secondary gate for opening a flume emptying



Apparatus for Regulating the Discharge of Water.

into the main flume. This cable moves in a direction the reverse of the cable which is carried by the main wheel, and supports the floater. The small gate wheel is loose on the shaft, but can be made, by means of a pin passing through hub and shaft, to revolve with the main wheel.

(4) Under the small secondary gate we placed another wheel, around which passed a cable (attached at one end to the bottom of the said gate and at the other end to the drum of a windlass above).

(5) Finally, above the small gate wheel we placed a turnscrew, by means of which the small secondary gate could be raised independently of the automatic operation of the apparatus. It is evident that, as the floater suspended from the main wheel falls with the water level in the reservoir, the consequent revolution of the gate wheel will raise the secondary gate, and thus increase the amount of water discharged at a lower head. The proper relation of this compensating increase is determined by the relative diameters of the two wheels, of which more will be said presently.

(6) When the reservoir is full the main gate is raised and the small gate wheel is pinned to the main shaft. If the water leaves the reservoir in excess of the supply, the consequent lowering of the water surface will depress the floater, turning the main wheel, and with it the small gate wheel. Both the cables concerned will be in high tension, one supporting the descending floater and the other raising the secondary gate; consequently, neither can, under ordinary circumstances, fail to operate. Moreover, there is no sudden change of the aperture of the secondary discharge, which is increased proportionately to the gradual descent of the floater until the reservoir is empty. When this has taken place the small gate wheel is loosened by the removal of the pin, the secondary gate is closed by means of the windlass, and the main gate being also closed the reservoir is allowed to fill again. During this process the cable supporting the floater is kept in tension by the counterweight.

It is easy to calculate for each case the pressure on the small gate to be overcome and the force required to overcome it in raising that gate, the ratio of diameters between the main wheel and the auxiliary gate wheel required to secure the necessary leverage, and the size and weight of floater required to overcome all frictions and raise the small gate. In this operation, however, the strain is greatest at the beginning, and diminishes to a minimum at the end. This variation is counteracted and the water line is kept at about the same place during the raising of the gate by means of a heavy chain hung above the floater and long enough to reach it when the water is very low. As the floater descends the amount of chain carried by it decreases to the extent required for a uniform action.

The calculation of the size of the auxiliary gate can be easily made when the reservoir is regular in shape. But for a reservoir of complicated form the necessary data must be obtained by observation and measurement. For this purpose the rise of the main gate is noted every 15 minutes after the start. The width of the gate and the amount of each rise are the sides of the rectangle for the opening. By combining these periodic observations the total area of the main gate opening is obtained; and the size and form of the small gate opening can be planned with sufficient accuracy.

The cost of the material of this device does not exceed $100. In fact, we used an old Pelton wheel, enlarged in diameter to 8 ft., with a rim made of planks for the grooves. The floater was made with two empty barrels attached to a frame supporting a box full of boulders. Some old pieces of chain, welded together, with a pulley and a windlass as the only new material, completed the system.

The results obtained thus far have saved us the wages of one man (by enabling one tender to do the work formerly requiring two) and 50% of the cost of keeping up the pipe line. Some better arrangement might be made, but it would probably be much more expensive, and this process may be of some value in remote countries where cheap installations are required. We are satisfied that the device could be made simpler in construction. Its installation was intended only as an experiment, but its operation has been so satisfactory that the temporary structure has become final.

*Extract of a paper presented at the London meeting of The American Institute of Mining Engineers.

†Watsonville, Cal.

ABSTRACT OF REPORT OF COMMITTEE ON STREET PAVING OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.*

The past tendency to depend for good pavements on bonds or guarantees is beginning to cease. The responsibility for good construction and maintenance is being gradually placed upon city engineers. Where a city depends upon a guarantee or bond, this means to transfer the responsibility from the engineer to the legal department of a city. Lawyers do not inspect a pavement and compel a contractor to keep it in good order. They wait till a pavement has become useless, as, for example, with poor brick and certain kinds of asphalt pavements injured by weather and light traffic, and then try to collect cash damages. The people would prefer to have a pavement on the street rather than a bond or cash damages. Your committee recommends that pavement guarantees be gradually abolished and that city engineers shall be made responsible to secure the best pavements of various kinds called for on different streets and roads. Architects are held responsible for the construction of public buildings. They do not depend upon guarantees for proper construction. City engineers see to it that sewers and water-works are constructed correctly. Such works do not depend upon bondsmen for lasting qualities. It is not the fault of the engineers, but generally of the legislative branches, that guarantees and bonds have displaced true inspection. Under the present political conditions, however, no engineer who insists and shows himself competent in preparing specifications and looking after pavement construction and repairs, is interfered with by aldermen or members of boards of works.

The principal kinds of pavements which have been laid during the past year are as follows: In large cities: A relatively decreasing amount of asphalt for new construction; a decreasing amount of granite block, but where laid the blocks are better laid than ever, and almost always on concrete foundations; an increase of the bitulithic pavement; an increase of treated wood block pavements on concrete foundation in a few cities; a small increase of brick pavement, much being with bet-

*Submitted at the Thirteenth Annual Convention, Birmingham, Ala., Oct. 9 to 12, 1906. James Owen, Newark, N. J., Chairman; J. W. Howard, New York, N. Y.; E. A. Harper, Kansas City, Mo.

ter bricks, with joints filled with cement grout and laid on concrete foundations.

In medium-sized cities: Very little granite and other stone block pavements have been laid, but more of it on concrete foundation than formerly; large amounts of the bitulithic pavement in many cities; a little treated wood block pavement on concrete foundation; a slightly increased amount of shale or better class of brick and a decreased amount of fire-clay or poor class of brick pavements; comparatively little asphalt pavement, except for resurfacing old asphalt pavements; some macadam, with and without telford foundation, to some extent in cities on outlying streets and avenues.

In small cities: Almost no asphalt pavement has been laid in the past year except in a few cities for the first time; a very little treated wood-block on concrete foundation in a few cities; a slightly increased amount of miscellaneous brick pavements in cities of the middle west; an increasing amount of bitulithic pavement in many cities previously using it, and in cities not having previously used it; macadam has been extensively laid as usual in small cities.

The best practical method, now extensively used in laying hydraulic concrete foundations for asphalt and bitulithic pavements, is to tamp the concrete until free mortar appears freely over the surface, then to immediately scatter or spread thereon a thin layer of clean broken stone 2 ins. or a little less in size, and tamp the stone about half its depth into the soft surface of the concrete. These stones are thus imbedded in the base and projecting above effectually roughen the surface of the concrete and prevent the binder coarse of an asphalt pavement, the asphalt pavement itself, or the bitulithic pavement surface, from slipping or forming rolls or waves. Your committee suggests that the specifications for concrete foundations of asphalt and bitulithic pavements would be improved by requiring tamping and roughening with clean broken stone as described above.

AN EXAMPLE OF RAPID BUILDING IN A MANUFACTURING PLANT.

Notwithstanding all the talk concerning the restrictions upon enterprise and energy which have been created by the omnipotent labor unions at the present day, we notice that hustlers in the structural business are still able to erect buildings for industrial purposes with surprising rapidity. A recent example of this is the new plant which is being built for the Kennedy Valve Mfg. Co., near Elmira, N. Y. This company recently bought a 22-acre tract on the eastern outskirts of Elmira, and is building there an entirely new plant, consisting of an iron foundry and iron machine shop, pattern shop and storage buildings and power house, all of which are now under construction, and buildings for brass working and a general office building now under contract. The accompanying photographs show two views of the site, one taken on Aug. 1, when the contractor started work on excavation; the second taken Oct. 1, showing what had been accomplished in two months, the iron frame of the largest buildings being then practicably completed. The buildings in the entire plant will cover an area of about 125,000 sq. ft. The general design is concrete piers supporting a steel frame, with brick walls and asphalt roof.

The pattern shop building is divided into three equal parts by fire walls with fire doors, and will contain the most modern fire appliances for fire protection—such as sprinklers, an independent fire service system, and two independent water supplies.

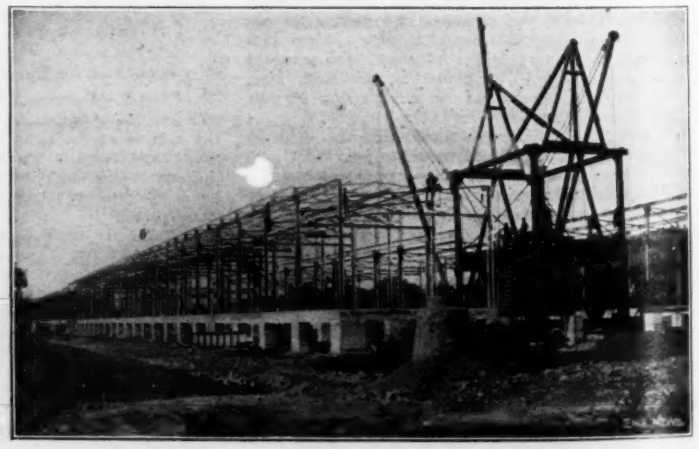
The iron foundry and machine shop buildings are an exact counterpart of each other, each having the same cross-section, and each containing 20-ton electric traveling cranes, with auxiliary hoists, running the full length of the building, as well as traveling cranes in the wings, all of the same span. The walls of the south end of the iron foundry and the north end of the machine shop are so constructed that they can, in case of future extension, be used on the sides to convert these two buildings into one—the 20-ton crane runways being extended and connected at the same time. A duplicate of this long building (760 ft. long) can also be made along side of the present buildings.

The power house, both in equipment and construction of building, is planned on the unit system, so that the future extensions will not interfere with operations—ample provision being made for the maximum equipment.

All the machinery throughout the plant will be motor-driven, the motors varying from 50 HP. down to 3½ HP., all controlled through a central switchboard located in the power house.

The power house also contains a 1,000-cu. ft. air compressor supplying compressed air to various shops throughout the plant. For testing purposes there is supplied, by special equipment, water up to 1,000 lbs. pressure, steam at 300 lbs. pressure with a superheater, giving a temperature of 500° F. when desired.

Site of the Plant Aug. 1, 1906.



Photograph Taken Oct. 1, 1906.—Steel Work of Two Buildings. 96 x 700 Ft., Erected.

RAPID BUILDING OF A MANUFACTURING PLANT; THE NEW IRON FOUNDRY AND MACHINE SHOP FOR THE KENNEDY VALVE MFG. CO., ELMIRA, N. Y.

PUBLIC DEBT OF THE UNITED STATES, 1870, 1880, 1890 AND 1902.*

The public debt of the United States includes that of the National Government, of the states or territories, of counties or parishes, and of cities and other minor civil divisions, such as villages, towns, townships, precincts, fire districts, irrigation districts, poor districts, school districts, etc.

The figures collected by the Twelfth Census and included in this advance summary are for the period designated as the fiscal year 1902. They include the debt at the close of that fiscal period which most nearly corresponds with the calendar year 1902, or for the fiscal year which ends between July 1, 1902, and June 30, 1903.

The total and per capita debt of continental United States and of its several political divisions and subdivisions in 1870, 1880, 1890 and 1902 are given in the accompanying table. The figures for 1890, with a few minor changes, and for 1880 are taken from the Eleventh Census report, and the figures for 1870 from the Tenth Census report.

*From a circular issued October, 1906, by the U. S. Department of Commerce and Labor, Bureau of the Census, Washington, D. C. (Only the detailed tables, by states, have been omitted.—Ed.)

	Net debt outstanding.							
	Total: 1 = 1,000,000				Per capita			
	1902.	1890.	1880.	1870.	1902.	1890.	1880.	1870.
Total	$2,789.2	$2,028.7	$3,042.6	$3,190.8	$35.49	$32.39	$90.66	$82.99
National Government	925.0	890.8	1,919.3	2,331.2	11.77	14.22	38.27	60.46
States and territories	234.3	211.9	274.7	352.9	2.98	3.38	5.48	9.15
Counties	196.4	145.0	124.1	187.6	2.50	2.32	2.47	4.87
Cities, villages, townships, precincts, etc.	[1]1,387.3	744.2	706.8	328.2	17.66	11.89	14.09	8.51
School districts	[2]46.2	36.7	17.6		0.58	0.58	0.35	

[1]Including debt of all minor civil divisions except school districts reported on the line for "school districts."
[2]Including all school district debt except that of cities, towns, villages and boroughs having a population of 8,000 or over in 1900.

With the exception of a few years—notably during the Spanish-American War—the national debt decreased from its maximum in 1865 to its minimum at the close of the period included in the foregoing table, June 30, 1893. The amount of the debt on August 31, 1865, was $2,756,431,571; this was an average of $79.44 for every inhabitant of the country. Prior to the Census report of 1870 this debt had decreased to $2,331,169,956. With the increase of population and this decrease of indebtedness the per capita national debt was reduced to $60.46 in 1870. With the further increase of population and decrease of debt each decennial period has recorded a corresponding decrease in per capita indebtedness, which at the close of the Census fiscal year 1902 was only $11.77.

During the period 1861 to 1865 the states and territories incurred large debts in connection with the Civil War, as did the National Government. The per capita of such state debt in 1870 was $9.15. The period 1870 to 1880 saw a marked decrease in the amount of this debt and a greater decrease in its per capital average. Similar changes in state debt took place in the succeeding decade—1880 to 1890. In the period 1890 to 1902 the greater number of states decreased their indebtedness, but a few states—notably Massachusetts—increased their indebtedness to a very large extent, and as a result there is an increase reported in the aggregate of state and territorial indebtedness. A large portion of the new debt in Massachusetts might, with almost equal propriety, have been classed with municipal indebtedness, since it represents obligations incurred by the state for the abolition of grade crossings and the building of armories, both of which are for the benefit of local communities, and for such local improvements as those of the metropolitan water, sewer, and park districts around the city of Boston.

In 1870 there was outstanding a relatively large county indebtedness, a considerable portion of which represented the credit of counties given to aid in the construction of railroads, but very little indebtedness of this last mentioned class has been incurred in the last twenty years. The actual county indebtedness decreased from 1870 to 1880, and since that time has been gradually increasing. From 1880 to 1890 this increase in county debt was less than the increase in population, but from 1890 to 1902 it was slightly greater.

The indebtedness of cities, villages, towns, townships, precincts, school districts, and other minor civil divisions must be taken as a unit to secure any just comparison for the various decades. In its reports for the Twelfth Census on municipal indebtedness of cities containing over 8,000 inhabitants, this Bureau has included the school district indebtedness with that of the city government proper. In 1870 the report of municipal debt included school indebtedness, with that of cities, towns, and other minor civil divisions; the aggregate of this indebtedness in 1870 was small—only $328,244,520, or $8.51 per capita. The succeeding decade saw a marked increase

in this indebtedness, an increase much greater than that in population, and in 1880 the per capita average was $14.44. The next succeeding decade saw a further increase in this indebtedness, but one less rapid than that in population, and hence the per capita average decreased from $14.44 to $12.47. The period from 1890 to 1902 recorded a very marked increase in this class of indebtedness, the aggregate outstanding in 1902 being more than four times as great as in 1870, with a per capita average of $18.24, or more than twice that of 1870.

CONVENTION OF THE STREET RAILWAY ASSOCIATIONS AT COLUMBUS, O.

Nearly a dozen electric interurban railways enter the city of Columbus, O. The entire area of the states of Ohio and Indiana is similarly rich in long-distance electric railway lines. No fitter place for a convention of street railway interests could be chosen than some point in these two states. Columbus was the convention city of the group of street railway societies recently reorganized under the general name, "American Street and Interurban Railway Association." Under its old name, American Street Railway Association, this body held its meetings of recent years in New York, Saratoga, and Philadelphia. While all these cities offer many matters of interest to street-railway men, the real territory of electric railway advance is in the rich rural communities of the Ohio and Mississippi Valleys. Therefore such minor matters as scant hotel facilities could not detract from the success of Columbus as a convention city for this purpose. Although the convention visitors overflowed the hotels, and some had to accept quarters in private families, this was more than counterbalanced by the attendance of half a dozen sumptuous "private" trolley-cars which brought parties of electric railway men from points as distant as Detroit, running over trolley tracks all the way.

At last year's convention there were four separate societies in simultaneous meeting. The reorganization plan put through at that meeting consolidated them, so that now there is a main or executive organization, the American Street & Interurban Railway Association, and three subsidiary societies of specialists: the American Street & Interurban Railway Accountants' Association, the American Street & Interurban Railway Engineering Association, and the American Street & Interurban Railway Claim Agents' Association. The meetings of these bodies at the Columbus convention were separate, except for one joint session. The combined meeting extended from Monday, Oct. 15, to Friday, Oct. 19, 1906.

Associated with this organization is a manufacturers' or supply men's society, the American Street & Interurban Railway Manufacturers' Association, whose sole function is to make exhibitions of street railway supplies and furnish entertainment for those attending the convention. For some years past these manufacturers' exhibitions have formed a very prominent feature of the street railway conventions. This year's exhibit was considerably in advance of previous ones in size, and in the interest which it awakened quite overshadowed the convention itself. It was hard to dodge the impression that the convention was an annex or sideshow to a large and bustling exhibition. To no small extent this effect may be charged to the fact that the meeting rooms were not only located right in the noise of the exhibition building (or group of buildings), but also were ingeniously bottled up in the maze of exhibit rooms, in such a way that the convention visitor had no choice but to traverse nearly the full length of the exhibition, about a thousand feet, from the entrance of the buildings to the meeting rooms.

The group of conventions was held at the Ohio State Fair Grounds, just outside the northeastern limits of the city of Columbus. An ample car service which the Columbus Railway & Light Co. maintained between the center of the city and the Fair Grounds (and which was free to all wearers of convention badges) brought the convention in effect very near to the hotels, the temporary homes of the two thousand visitors.

The work of the convention was done in 20 separate sessions; of these the main or American Association held six, the Accountants four, the Engineering Association five and the Claim Agents' Association five. Entertainment was abundantly provided for the evenings, by a reception, a theater party for which the entire seating capacity of the two leading theaters was bought, a banquet, an amateur vaudeville performance, etc. If the claims of the exhibition be also remembered, it will be seen that the week was a busy one.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION.

The present convention of the "Engineering" branch showed a much more active and interesting program of papers than offered at any previous meeting; particularly is this so in comparison with the papers of last year (see Engineering News, Oct. 5, 1905, p. 358).

The committee reports presented little of interest, but produced considerable discussion. In discussion of the report on Control Apparatus it was brought out that the few cases in which street cars intended to be run singly have been equipped with multiple-unit control apparatus continue to show excellent service. In Kansas City, where the grades are steep and consequently the amperage per car unusually high, 30 cars thus equipped have been run for some time, operating always as single cars; the elimination of burnouts of platform controllers, which accidents often produce a panic on the car, is felt to be very advantageous, and it is likely that another lot of cars in that city will be similarly equipped.

Mr. G. J. Smith (Kansas City, Mo.) believes, however, that it will be better to operate the reversing switch mechanically (instead of indirectly as in the multiple-unit systems), because a simultaneous failure of brakes and reversing contactor may leave a car helpless on a down grade.

At Concord, N. H., a number of street cars equipped with multiple-unit control have been operating singly and in trains for five years, with good results. A number of cars in Boston have been equipped with multiple-unit control, and these are giving good satisfaction.

Efforts on the part of manufacturers to reduce the bulk of multiple-unit control apparatus, so that it will be easier to find place for it under a street car, are continuing. A controller 16 × 14 × 15 ins., weighing about 325 lbs., capable of handling two 100-HP. motors, has been developed by the Westinghouse Electric & Mfg. Co.

There is great promise, however, in the system first applied at Milwaukee, and later at Baltimore, comprising an ordinary platform controller combined with two "contactors" or automatic switches, the latter being located under the car. In this system the contactors operate when the circuit is opened, so that the danger of arcing and flashing at the platform controller is eliminated. This system was first described by Mr. E. W. Olds (Milwaukee Electric Ry. & Light Co.), Milwaukee, Wis., at the 1905 convention.

The report of the Committee on Maintenance and Inspection of Electrical Equipments was largely in advocacy of a mileage system of inspection. Perfect satisfaction and material reduction of cost of inspection result from the practice of inspecting cars after a fixed mileage (instead of after a fixed time). The system is now exclusively used by the Interborough Rapid Transit Co., New York, N. Y., and has recently been introduced by the Boston Elevated Ry. Co., Boston, Mass. On the Interborough each car is inspected after 1,000 miles run, and cars are shopped for general repairs after 65,000 miles; armature-bearings are oiled every 1,000 miles, and motor-axle and journal bearings every 10,000 miles. Several speakers testified to the value of oil wick lubrication, as against grease lubrication, in enabling longer running between inspections.

The Committee on Standardization reported that an inquiry is now proceeding on the subject of electric railway practice in brakeshoes, flange and tread of wheels, rails, journal bearings and journal boxes. The report elicited some sentiment in favor of immediate recommendation of tentative standards, especially the M. C. B. brake-head and M. C. B. journal sizes; but no action was taken. It is likely that great trouble will be had in arriving at satisfactory standards for flange and tread dimensions of wheels, and for rails, the former on account of the limitations imposed by narrow head and small groove of much existing track, the latter on account of rolling-mill difficulties and the varying ideas of rail designers.

A communication from the Central Electric Railway Association was read, urging the immediate adoption of certain standards, as follows: the M. C. B. standard type of brake-shoe, brake-head and key; the M. C. B. standard sizes of journal bearings, 3¾ × 7, 4¼ × 8, and 5 × 9 ins., and the M. C. B. type of box, bearing and key; a wheel tread 3 ins. wide, flange ⅞-in. high and 1 1/16-in. thick at throat, for both city and interurban work; the T-form of rail for both city and interurban work. The letter was referred to the Committee on Standardization.

A paper on "Ballast," by Mr. Chas. H. Clark (Cleveland Electric Ry. Co.), Cleveland, O., described several current methods of building foundation for electric car tracks. Steel tie construction in concrete, laying the ties 4 to 10 ft. apart, was stated to be cheaper than oak tie construction when white-oak ties cost 80 cts. each. The life of steel tie construction was placed at 20 yrs., that of oak ties at 12 yrs. First-class concrete in the foundation work is required, as poor concrete pounds to pieces. The author recommended 1 : 3 : 6 stone concrete.

Mr. F. G. Simmons (Milwaukee, Wis.) stated that in Milwaukee cedar ties are used, spaced 2 ft. on centers, with 6 ins. of concrete below the ties, and concrete up to the top of tie or in case of 7-in. rail up to 1 in. above the tie. A much longer life of tie than 12 yrs. is secured by the concrete protection. The concrete, 1 : 2½ : 5, is given a week to harden before cars are run over the track. Before laying concrete, the subgrade is tamped, rolled or flooded to make it very solid.

Mr. C. A. Alderman (Cincinnati, O.) believes that 6 ins. of concrete under the tie will not stand the traffic of interurban cars coming into a city, and favors a loose ballast, gravel or stone, especially because this is easier to repair. He has used 1 : 2½ : 5 concrete. Mr. J. M. Larned (Pittsburg, Pa.) said that in Pittsburg the ties are placed on broken stone, and concrete is used only between the ties where the pavement requires. Cedar ties were reported to have given good service in Chicago, by Mr. H. B. Fleming; after 18 yrs. of service they could still be relaid. Mr. Martin Schreiber (Public Service Corp.), Newark, N. J., favored stone ballast and wood ties, white-oak or chestnut. Consideration of the rolling stock forbids too rigid a track.

Under the title "Ties, Poles and Posts," Mr. C. A. Alderman (Cincinnati Northern Traction Co.), Cincinnati, O., quoted from his company's specifications for ties, and stated that ties cost 65 to 70 cts. delivered, in Ohio and Indiana. These ties are required to be of white-oak, burr-oak, chestnut-oak, black locust, black walnut, or wild cherry, and the following minimum dimensions are allowed, on normal dimensions 6 ins. thick by 8 ins. wide by 8 ft. long:

(To constitute not more than 5% of order.)

First-class ties:	Pole ties.	Split ties.	Sawed ties.
Depth not less than.....	5¾ ins.	5¾ ins.	6 ins.
Face not less than.....	6 ins.	7 ins.	6 ins.
Face swell not less than.	8 ins.	.....	8 ins.
Length .....7 ft. 10 ins. to 8 ft. 2 ins.			8 ft.

(To constitute not more than 10% of order.)

Second-class ties:	Pole ties.	Split ties.	Sawed ties.
Depth not less than.....	5½ ins.	5½ ins.	5½ ins.
Face not less than.....	4½ ins.	6 ins.	6 ins.
Length not less than....7 ft. 10 ins.		7 ft. 10 ins.	8 ft.

Trolley poles are stated to have increased from 25 ft., with 6-in. top, to 35 and 40 ft. in height, with 8-in. top, the longer length being always used where the alternating-current transmission line has to be carried on the same poles.

Poles have pretty generally been used of cedar, although quite a number of juniper from the Southern

States have been used. Chestnut poles have also been used, but their great weight caused them to be quite objectionable to erect. Idaho cedar, so-called, is coming into the market very lively just now as a trolley pole timber. The poles are very straight and fine looking, but are not stocky or massive like Michigan cedar. Their size at the butt is but very little larger than at the top. As to their lasting quality I do not think they have been in use long enough yet for us to give a reliable opinion.

Creosoting of trolley poles has been tried to a small extent. The opinion of Mr. Crump (Ford, Bacon & Davis, New York, N. Y.) is quoted to the effect that creosoted poles are much better conductors than untreated. He says: "In our regular work we double insulate all our spans in the same manner that we would for steel pole construction." Concerning fence-posts, the paper recommends red cedar, 7 ft. long with 4½ to 5-in. top. A reinforced-concrete trolley pole is suggested, 40 ft. long, 4½ by 5¼ ins. at top, and 7½ by 7¾ ins. at bottom, with four ⅜-in. longitudinal rods.

In discussion, Mr. H. B. Fleming (Chicago, Ill.) stated that white cedar trolley poles of the Chicago City Ry. Co. have been in service since 1893. Mr. E. J. Dunne (Newark, N. J.) gave 15 to 20 yrs. as the first-class cedar poles, or double the life of an iron pole. In Milwaukee, Wis., Mr. F. G. Simmons stated that after 8 to 9 yrs. only 7% of a line of white cedar poles required replacing. Mr. G. J. Smith (Kansas City, Mo.) stated that white cedar poles have been in use 13 yrs. in western Missouri. An interesting piece of work was described by Mr. A. B. Lambe (Toronto, Ont.). At St. Catherines, Ont., a 20,000-volt line crosses a deep valley, and for this crossing two 150-ft. poles of reinforced concrete were put up. These are about 2 ft. square at the base, tapering upward, and weigh about 50 tons each. They were made on the ground and were raised by a derrick. The first one broke in raising "because it was not lifted at enough points."

A paper on "Gas Engines," by Mr. Paul Winsor (Boston Elevated Ry. Co., Boston, Mass.) described the equipment and operative results of two small auxiliary power stations of the Boston traction lines. The plants are of 700 and 975 KW. capacity, respectively, and use producer gas. They have proved very satisfactory, and highly economical, consuming only 1.45 lbs. coal per kilowatt-hour. This figure was made on a very steady load, however; the engine load-factor has averaged about 74%. We expect to give a fuller abstract of this paper in another issue. The discussion added no important items of information.

"Underground Cables," a paper by Mr. H. G. Stott (Interborough Rapid Transit Co., New York, N. Y.) contained much interesting matter. The author classified cables into (1) High-tension cables, carrying small currents at 2,500 to 25,000 volts effective voltage; (2) Low-tension single-conductor cables, for large currents at voltages of 650 volts or less; (3) Negative return cables of large current-carrying capacity but with pressure only as large as the drop in the return feeders. In the first class, rubber insulation is used where moisture must be apprehended, to avoid breakdown when the lead sheath is punctured; paper may be used for other conditions, but above 22,000 volts it is likely that impregnated cloth will be better, because of its higher puncture resistance. The lead sheath should be insulated and wrapped with asbestos, in the manholes, to avoid the destructive effects of return currents flowing in the lead sheath and leaving it at cable-hangers. The lead sheaths should all be connected together and grounded in the station. The neutral point of the generator should be grounded through a resistance sufficient to limit the current when a ground occurs on a high-tension feeder, and trip an overload relay before the cable is further injured or a short-circuit between phases occurs. The method of insulation and wrapping in the manholes should also be used for low-tension cables, and a pilot-wire connected to the sheath should be brought to the switchboard to give early warning when a feeder grounds on its sheath. In laying duct for lead-sheathed cable, great care should be taken to get a smooth conduit, as the sharp projections so often found, and rough joints, will seriously damage the sheath when drawing the cable in.

The most interesting part of the paper deals with return feeders and electrolytic troubles:

Class III. cables have up to within the last three years received very little attention, as, in almost every case, bare copper cables were installed. But a closer study of the electrolysis problem indicates that in many instances the use of insulated negative cables would eliminate a great deal of the trouble and damage to cable sheaths, etc.

When electricity leaves a conductor in wet or moist ground the water in its path is decomposed into its constituent gases, and oxygen attracts almost all metals, forming an oxide of iron or oxide of lead or copper, as the case may be, slowly but surely destroying the metal.

A pressure of two volts is sufficient to decompose the water, so that the ordinary negative drop of from 5 to 25 volts possesses ample possibilities in the way of electrolysis, if not properly taken care of.

In the ordinary location of D. C. power plants in our smaller cities, only one generating station is used, and sufficient positive copper is installed to give the necessary potential on the trolley, the negative or return circuits being taken care of by the track rails up to the nearest point to the power plant or substation, and from this point bare negative feeders are used to conduct the current back to the grounded negative bus in the station. The maximum amount of copper installed in this negative rarely equals that used for the positive, so that in all probability there will be at least 5 volts drop from the nearest track rail to the negative bus, and if longer bare negative feeders were used running to the various points of heavy traffic, the drop on them will be at least 4%, as the financial burden caused by interest on capital invested becomes too great if a smaller drop than this is used. We thus have bare negative feeders with a potential of from 5 to 25 volts on them, running parallel to our positive and righ tension feeders, as well as our neighbors' cables, gas mains, water mains, etc., and a few bad rail bonds may increase this drop several per cent.

The negative feeder may, therefore, be looked upon as an infinite number of small battery cells coupled in series with their negative pole coupled to the negative bus in the power-house or substation, and their positive coupled to the track rail, with some good and some bad connections all along the line to the various lead sheaths of the cables running near them as well as to gas mains, etc. If the connections between one of these imaginary cells and a lead sheath be sufficiently good, then this battery's potential of perhaps ten volts will be on the cable sheath and will cause a current to flow from it at some other point along the line where the negative return is at a lower potential. At the point where the current leaves the lead sheath, electrolysis will occur, and in time the feeder will break down from the moisture admitted through the perforated lead sheath.

The above conditions obtain to a greater or less extent in all systems having bare negative returns and grounded negative bus bars, no matter how many substations may be in use.

An obvious remedy would seem at first to be the bonding of the lead sheaths of all feeders to the bare negative cables at frequent intervals, but this introduces another trouble which may be as serious as electrolysis. A short-circuit in a positive feeder, to ground, will cause an enormous current to flow through the lead sheaths, and in all probability burn off the bonds and destroy the lead sheaths in a number of cables. Instances of this have occurred to the author's knowledge, in which the lead sheaths have been completely burned off for four hundred feet on cables that were entirely innocent of the origin of the trouble.

Another source of trouble, due to the use of the grounded negative bus and bare feeders, is in the other feeder's lead sheaths carrying the negative current back to the power-house or substation by an entirely different route from that taken by the bare negative feeders, with the result that this return current leaves these lead sheaths, either in the power-house through a ground put on them, or through some accidental ground, such as a cable hanger in a manhole. Every time a short-circuit comes on the system a rush of current will flow through these lead sheaths and, perhaps, puncture small holes in the lead.

The most satisfactory solution of these problems of avoiding electrolysis and saving the lead sheaths from destruction seems to be in the use of an insulated negative bus in the power-house and substation, and insulated negative feeders right up to the track rails. For this purpose, the negative feeders should preferably be insulated with some material which does not require the use of a lead sheath. Several types of insulation are now on the market, which promise to be very satisfactory for this purpose, as the potential carried by the negative feeders is quite low.

By using insulative negative feeders and avoiding all grounds in the power-house, or substation, it is evident that there will be little or no tendency for the return current to leave the track rails, if properly bonded, and absolutely no tendency for stray currents to come back to the power-house or substation by way of lead sheaths, gas mains, etc., thereby relieving us of probably 75% of our present electrolysis troubles.

Mr. W. B. Reed (New York, N. Y.) confirmed the author's warning against the injurious effect of sharp points in vitrified duct and roughness at joints. Concerning the value of rubber insulation, he said that the first high-potential cable in New York City was laid in 1886 and remained in use for 14 yrs. It had no lead sheath. But better rubber was then obtainable than since automobiles have caused a great rise in the price of rubber. Mr. Winsor (Boston, Mass.) reported that he had had so much trouble with return currents in the lead sheath that he now cuts the lead for an inch or two on either side of the manhole to break the continuity. He described an unusual method of specifying cables used by his company: a guarantee is required that the insulation resistance shall not go below a certain value in a fixed number of years. Periodic tests are made and records of cable insulation are kept, to follow the drop in resistance. Mr. H. N. Latey (New York, N. Y.) described the return conductor system used in the New York subway. As one rail was required for the signal current, the return drop threatened to be very large. Insulated negative cables were put in, tapping four points between substations. This gives a drop of 60 to 70 volts on the return, but only 5 or 6 volts between the rail and neighboring water-pipes.

A suggestive paper was read by Mr. W. Goodenough, of Boston, Mass., under the title "The Relative Economy of Turbines and Engines at Varying Percentages of Rating." The paper assumes certain costs of steam engines and steam turbines and their auxiliaries, and also the price of coal, and proceeds to compute curves of cost of power per kilowatt-hour when these plants are run at various percentages of rated output. The curves show that engines reach their minimum cost of power (fixed charges plus operating cost) in the neighborhood of 100%, or full load, while the steam turbine plant is most economical at 130 to 150% of full load. These values apply of course only to the particular cases computed, but the comparison will hold true for all cases. Since it is impracticable to run a generating plant at anywhere near 140% of its rating, the advantage in this respect favors the engine. The curves show, also, that the steepness of the power-cost curve at the working point, say 100%, is not very different for engine and turbine. The great influence of the fixed charges profoundly modifies the flatness of the coal-consumption curve of the turbine.

The last paper before the Engineering Association was "Economy in Car Equipments, Weights and Schedules," by Mr. E. H. Anderson (General Electric Co.), Schenectady, N. Y. The character of this paper forbids brief summary. Stated generally, the author shows that the number of stops per mile is of enormous effect on the speed and the power-consumption of a given car-equipment, and that high-speed equipments in a service having many stops are an economic mistake because they give very little higher speed than a lower-speed equipment, at much greater power cost.

Mr. N. W. Storer (Pittsburg, Pa.) in discussion made the point that the selection of the gear-ratio is of very great importance. By gearing for too high a speed, the motors are run at low voltage most of the time, heat greatly and have low effective capacity. In one case the average voltage on the motors, while current is on the car, is only 275 volts, against 550 volts on the trolley. On the other hand, gearing for too low a speed means that the motors must be forced, to make the schedule, and the brakes put on at full speed, thereby wearing out brakes and coil-pile at the same time. The most common error, however, is in using too high a gear, an error specially common in interurban work, where the track usually does not permit

the speed of which the motors are capable. He also emphasized the value of multiple-unit control with automatic acceleration, in preventing slipping of wheels during starting, and thereby making two-motor equipments of two-truck cars do the work for which otherwise the full adhesion of the car, i. e., four-motor equipment, would be required.

The question of gear, and selection of size and type of motor required, was also discussed by several other speakers, in the same general trend. The higher maintenance cost of equipment which is geared for too high a speed was also brought into evidence from a concrete case.

OTHER SOCIETIES.

The work done by the main association, and by the Accountants' and Claim Agents' associations, can be mentioned only by title.

The work of the American Steel and Interurban Railway Association dealt mainly with business and administrative matters. Committee reports on subjects such as Insurance, Promotion of Traffic, Compensation for Carrying Mail, were received and discussed. The discussion on Insurance was perhaps the most animated part of the meeting. It was, however, directed wholly toward rates, how to get low rates, whether cooperative insurance is feasible, etc., and did not refer to fire-resisting construction or means for fire protection. Apparently the lower insurance rates of recent years on car-houses and similar property are charged wholly to competition and not to real progress in minimizing the risk of fire damage. Papers were read as follows, mostly with little or no discussion: "Elevated Railways and their Bearing on Heavy Electric Traction," by Mr. H. M. Brinckerhoff, of New York, N. Y.; "Electric Railways in Sparsely-settled Communities," by Mr. E. P. Roberts, of Cleveland, O.; "Interurban Freight and Express," by Mr. E. C. Spring, of West Milton, O.; "Tickets and Rates," by Mr. F. W. Coen, of Cleveland, O.; "Some Notes on the Evolution of Electric Transportation," by Mr. T. Stebbins, of Cohasset, Mass.; "Electric Railway Employees and the Young Men's Christian Association," by Mr. E. M. Willis, of New York, N. Y.; "Selection of Trainmen," by Mr. C. E. Larned, of Boston, Mass.; "Discipline of Trainmen," by Mr. F. W. Brooks, of Detroit, Mich.; "Uniforms and Badges," by Mr. J. R. McGivney, of New Orleans, La.; "Handling Public Complaints," by Mr. J. A. Beeler, of Denver, Colo.; "Leaks between Passenger and Treasurer," by Mr. A. H. Stanley, of Newark, N. J.

The Accountants' Association dealt with the following papers: "The Accounting of Capital Expenditures," by Mr. P. S. Young, of Newark, N. J.; "The Use of Curves in Statistics," by Mr. A. S. Pratt, of Boston, Mass.; "Depreciation as Applicable to Electric Railways," by Mr. R. N. Wallis, of Fitchburg, Mass.; and a committee report on Standard Classification of Accounts.

The Claim Agents' Association discussed papers as follows: "Which is the Better Policy, Quick or Delayed Settlements?" by Mr. A. J. Farrell, of Buffalo, N. Y.; "The Policy of the Claim Department toward the Public," by Mr. W. F. Weh, of Cleveland, O.; "The Claim Agent's Work of the Future," by Mr. C. W. Hare, of Philadelphia, Pa.; "Methods of Management of Claim Departments," by Mr. H. C. Bradley, of Chicago, Ill.

NEW OFFICERS.

Mr. W. C. Ely, who was president of the American Street Railway Association for two years and during the past year has had the presidency of its successor, retired from office at the present convention. Mr. John I. Beggs (The Milwaukee Electric Railway & Light Co., Milwaukee, Wis.), was elected to succeed him. Prof. B. V. Swenson continues as secretary and treasurer of the American Street & Interurban Railway Association.

The American Street & Interurban Railway Engineering Association reelected Mr. H. H. Adams (United Railways & Electric Co., Baltimore, Md.) as president, and Mr. S. W. Mower (Southwestern Traction Co., London, Ont.) as secretary.

The American Street & Interurban Railway Accountants' Association elected as president for the coming year Mr. C. L. S. Tingley (American Railways Co., Philadelphia, Pa.), and as secretary (reelected) Mr. E. M. White (Birmingham Railway Light & Power Co., Birmingham, Ala.).

The American Street & Interurban Railway Claim Agents' Association reelected its president and secretary, Mr. S. L. Rhoades (Philadelphia Rapid Transit Co., Philadelphia, Pa.) and Mr. B. B. Davis (Columbus Railway & Light Co., Columbus, O.).

RAILWAY SIGNAL LAMPS AND SPECIFICATIONS FOR SIGNAL LAMP OIL.

At the Washington meeting of the Railway Signal Association held Oct. 16-18, the committee on signal lamps recommended the adoption of top-draft lamps in preference to those of bottom draft construction. Preference was given the former type chiefly on account of the trouble of condensation in the latter form of lamp. It is very important, however, in the top draft system of ventilation, to prevent the air entering the lamp from coming directly over the chimney, as it is liable to extinguish the flame when using the long burning fount. According to the committee's report:

One method of overcoming this is to have the system constructed so that the air chamber descends into the body of the lamp, and having a vertical perforated cylinder forming the side walls and an imperforated upper wall, the two being connected by an inclined cone. The air chamber thus formed should be divided into parts by the use of vertical wings. Another method is to have a solid cone, bell shaped, at the bottom with two perforated plates, the upper or smaller of the two to have circular perforations, the lower plate to have elongated perforations.

By the use of either of these methods, the air entering the top of lamp follows the outside of cone, passes through the perforations and diffuses, thus breaking a straight draft, strikes the inside of body of lamp which it follows, and thereby prevents any condensation or sweating on the sides of lamp or lenses.

To demonstrate the higher efficiency of the top draft system of ventilation over the bottom draft system, the lamp failures for one year, due to faulty construction on a road having 4,030 lamps in use, are presented in the committee's report. They are as given in the accompanying table:

Lamp Failures Due to Faulty Construction.

Cause of failures.	No. reported.	Top draft.	Bottom draft.
Broken chimneys...	56	9	47
Defective fittings...	81	..	81
High wind.....	74	..	74
Light wind or smothered	260	..	260
Smoked chimneys..	21	..	21
Total	492	9	483

Of the 4,030 lamps, 3,700 were equipped with long-time burners. About 80% of them were bottom draft, the remainder being top draft. Of the 81 failures due to defective fitting, 35 were caused by leaky founts; these were made of tin and had been in service several years. The other failures were defective burners, broken reflectors, and poor wicks.

The specifications recommended by the committee for illuminating oil in signal lamps, were as follows:

Sample must not flash below a temperature of 110° F. in the "Elliot" closed cup, nor burn below 160° F. in the "Tagliabue" open cup when heated at the rate of 2° per minute and flame applied every 2° beginning at 100° F.

Must be not less than 47.3 Baume, or 0.7896 specific gravity.

Must be strictly water white in color and remain perfectly clear and transparent when cooled to a temperature of zero and held there for 10 minutes. Oil must be perfectly neutral showing neither acid nor alkaline reaction.

A sample will be taken from each carload or part carload lot, either in bulk or in packages, and such sample shall be considered representative of the entire shipment.

All samples will be taken with a thief.

The oil must burn steadily and clearly in a suitable lamp, without smoking and with a minimum incrustation of the wick for a period of at least 100 hrs.

Any sample failing to meet all the requirements of this specification will be condemned and the shipment represented by it will be returned to the manufacturer at his expense, he paying for freight both ways.

As the question of successfully using the long time burner is still a matter of doubt in the minds of some, the committee would state that there is no question but that they are a success both from an economical as well as from a practical standpoint. In maintaining lamps, the same care should be taken as with any other branch in railroading. The lamps must be properly looked after and those responsible should see that they get the attention they require. The old method of putting "drill outs" to look after lamps never was a success and never will be.

In conclusion, the committee submits the following data which may be of interest to the members, relative to the oil consumption and cost of maintenance, basing same on lamps showing failures:

Number of lamps	4,030
Number of gallons oil used.....	46,688
Number gallons oil used per lamp per annum.....	11.59
Cost per lamp per annum for maintenance.....	$7.64

This cost includes all labor, repairs to lamps, as well as oil, wicks, etc.

CLEANING METAL ARTICLES BY THE ELECTRIC CURRENT.*

By H. S. Coleman.

Under certain conditions, work, consisting of iron and brass articles to be nickel-plated, may be cleaned by means of the electric current. The author of the present paper having large quantities of this kind of work to deal with, could not get sufficient scoured by hand to keep the plating vats fully loaded, and after increasing the staff of operators and getting but little better results he tried cleaning the articles to be plated by means of the electric current. His observations and deductions are worthy of note.

Cleaning by this means is due to an electrolytic, and not merely a chemical change, for, unlike ordinary potash cleaning, the same result is obtained by using a cold bath. The cleaning, however, is very much slower than with the hot bath. Electrolysis takes place, and minute quantities of metallic sodium (using sodium hydrate solution only) appear around the cathodes (work), and occasionally take fire. In actual working it is much better to use the hot solution.

By this process the grease, which consists chiefly of tallow, is saponified and remains in solution. The lighter dirt is thrown upon the surface of the bath and may be skimmed off, the remainder, consisting of very fine emery, falling to the bottom of the tank.

A working plant capable of cleaning a considerable quantity of work per day consists of the following, the necessary current being supplied from the plating dynamo:

There is a wrought-iron tank containing the cleaning solution. Over each end is erected a wooden structure, clear of the tank, to support the rods on which the work hangs. Along the top of each support is a flat copper strip, which is connected to the cable by means of a stud. The rods are made of hard-drawn copper. These make surface contact only, owing to the variety of articles to be cleaned. There is a resistance board and change-over switch in the circuit.

In the first stage of the process the iron tank is used as the anode, and the work as the cathode. A voltmeter is connected across the terminals of the bath for recording the difference of pressure, the current being recorded on the ammeter placed in the main circuit from the dynamo. The cleaning bath is made up of equal quantities of brown Montreal potash and sodium hydrate dissolved in water and kept boiling, sp. gr. 18° T.

The work, after wiring up in the usual way, is distributed along the copper rods in small bunches. The current is now switched on and adjusted until a difference of pressure of 2½ volts is recorded on the voltmeter. Immediately the surface of the work begins to change color; this takes from 5 to 10 mins. The current is then reversed for a short time, usually 30 to 40 sec., until the surface is clear and bright. It is then switched off, and if the work is still dirty the operation is repeated. It is then thoroughly swilled in clean, cold water, passed through suitable dipping solutions, electrocoppered, passed through clean, cold water again, and transferred to the plating bath.

The advantages of this process are:

(1) The work is cleaned in one-third of the time occupied by the older method of scouring by hand.

(2) It is all wired up ready for plating, and the surface is not touched again by the hand until it is unwired after plating. This not only prevents a certain amount of stripping, but also saves the considerable time which would be occupied in wiring up again, after scouring by hand.

(3) The work is rendered chemically clean due to the action of the current working out all grease and dirt from parts where it is impossible to scour with a brush.

(4) Time is saved in filling the vats, thus giving an increased output.

(5) Saving of labor and materials.

NEW SEWERAGE AND SEWAGE DISPOSAL WORKS at Dublin, Ireland, have recently been completed at a cost of about $2,500,000. The improvements include about eight miles of main sewers, with tunnels beneath the Dodder River and cast-iron siphons beneath the Grand Canal and Midland Railway, a 75,000,000 U. S. gal. pumping station, and precipitation tanks covering an area of 100 × 1,000 ft.

*Abstract of a paper read before the "Faraday Society."

ANNUAL CONVENTION OF THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

The sixteenth annual convention was held at the American House, Boston, Mass., Oct. 16-18. Of the 347 members, about 150 were in attendance. Included among these were 35 new members who enrolled during the opening meeting.

The convention was called to order 10 a. m. Tuesday, by the president, Mr. J. B. Sheldon (N. Y., N. H. & H. R. R.), and an address of welcome was given by Mr. Lucius Tuttle (B. & M. R. R.).

President Sheldon's address briefly reviewed the history of the association since its beginning in 1891. The present membership represents 170,000 miles of railway.

On the evening of the second day addresses were made by Prof. Geo. F. Swain, of the Massachusetts Institute of Technology, and Prof. L. J. Johnson, of Harvard. A trip by special trolley was made Thursday afternoon over the Paul Revere Route, including Bunker Hill and Lexington, and stopping at Harvard University on the return. On Friday a special train was tendered the members by the B. & M. R. R. for a visit to Manchester, N. H., to inspect the large cotton manufacturing plant there; on the return trip a visit was paid to the U. S. Navy Yard.

At the business session on the first day routine matters were transacted. The report of the treasurer showed a balance on hand of $1,098.55. By a unanimous vote the salary of the secretary, S. F. Patterson, of Concord, was increased from $300 to $600 per year. At the final meeting the following elections were made for the ensuing year: J. H. Markley, President; R. H. Reid, First Vice-President; J. P. Canty, Second Vice-President; H. Rettinghouse, Third Vice-President; F. E. Schall, Fourth Vice-President; S. F. Patterson, Secretary; C. P. Austin, Treasurer. A new executive committee was also elected, and resolutions were passed to hold the convention next year at Salt Lake City, Utah.

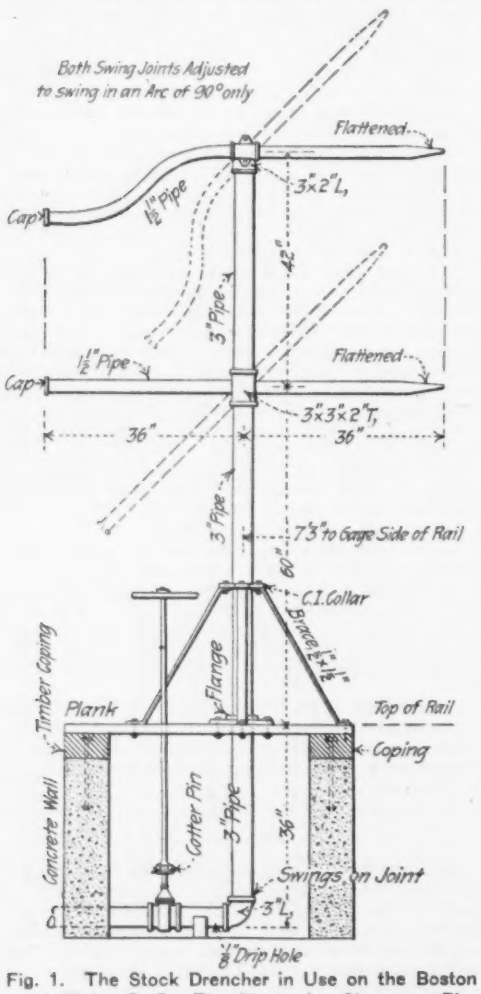


Fig. 1. The Stock Drencher in Use on the Boston & Maine R. R. The Illustration Shows an Elevation of the Drencher Square to the Track and Ready to Use.

PROFESSIONAL PROCEEDINGS.

All of the papers presented were in the form of reports of committees. There were 15 subjects to be reported upon at this meeting, but reports on only about half of them had been worked up by the committees. Although there were no reports on the remaining subjects the discussions on them were particularly full, especially on those relating to concrete construction.

METHODS OF WATERING STOCK IN TRANSIT.—This report was compiled by a committee of which Mr. J. N. Penwell (L. E. & W. Ry.) was chairman. Only about 50% of the roads heard from have any appliances for watering stock in transit. Of these, 10% depend entirely on a goose neck in the water tanks for the supply, these being roads that do not handle stock extensively.

Where any fixed appliance is provided for watering and sprinkling stock, the plan furnished by the Boston & Maine R. R., and shown in elevation in Fig. 1, seems to be the most feasible. This plan consists in the use of a frost-proof box for protecting the pipe in freezing weather and is easily closed and abandoned during the winter months. The hose with connection to supply pipe is a very convenient appliance, but is somewhat expensive on account of its not always being well cared for. The device in Fig. 1 is for drenching hogs on cars in transit, and permits throwing water on both the upper and lower decks at the same time. The average distance between water tanks equipped for drenching hogs or watering stock is about 26 miles.

Mr. R. H. Reid (L. S. & M. S. Ry.) pointed out the desirability of using flat nozzles on the drenchers so as to readily send the stream of water between the slats of the cars while passing.

BUMPING POSTS FOR PASSENGER AND FREIGHT USE.—Mr. A. E. Killam (I. C. Ry.) was chairman of the committee that brought out this report. Of the 36 replies received with regard to bumping posts:

Twenty-seven wrote in favor of the Ellis bumping post, passenger and freight cars; five in favor of either the Ellis or Gibraltar bumping posts, one as good as the other; two consider the Gibraltar bumping post the better one; two consider a pile bumping post the best where it can be put in.

Many of the replies favor, beside the Ellis and Gibraltar patterns, bumping posts such as a pile of earth and elevated ends of rails; some, posts set deep in the earth well braced; some, pile bents as before mentioned; also the Economy train bumper, and others of much merit.

There appears to be no doubt that the Ellis and Gibraltar, with one or two styles near akin, are the most acceptable bumping posts for such places as in terminal stations; ends of sidings ending against a street or building; on a trestle or wharf, or such places where a cheaper device cannot be satisfactorily used.

The Ellis bumping post for trestles is shown in Fig. 2, and the Gibraltar bumper is shown in Fig. 3.

Pile bumpers are efficient, but as their average life is only from 5 to 7 years, it is questionable if they should be recommended for general use. While generally strong enough they have been known to break at the ground surface when entirely new. It is undoubtedly true that in many cases it would be economy to leave the tracks without bumpers, as cars are less damaged by running off the ends of rails into a pile of dirt than into any bumping post.

Mr. J. H. Cummin (L. I. R. R.) said he had found spiral springs much less expensive than rubber, and equally satisfactory for use on bumpers for passenger cars.

Mr. R. H. Reid (L. S. & M. S. Ry.) believed it to be impossible to build bumpers that would prevent damage to heavy cars. He considered pile bumping posts stronger than those of the Gibraltar type. These should be built with seven piles grouped together. The best bumper for slow trains is a pile of dirt or gravel 30 ft. long, 10 ft. wide, and 5 ft. high. The dirt allows time to elapse before the car is stopped, and less damage is done to the car than by any other form of bumper. Although the pile bumper is probably the next best, the energy of impact is here not expended in the bumper but on the car; the damage is done, therefore, not to the bumper which can cheaply be replaced, but to the costly car.

Spring bumpers, according to Mr. Reid, are preferable to rubber bumpers because with the former almost any amount of resilience can be obtained, and the latter deteriorate rapidly when

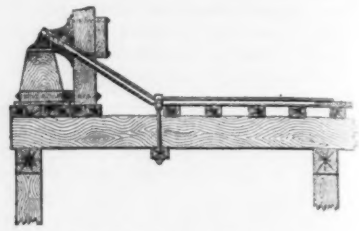


Fig. 2. The Ellis Bumping Post for Trestles.

exposed to the weather. Except in special cases he did not consider it advisable to install expensive bumpers whose chief merit is their stability. Such bumpers are necessary only where the overrunning of a car at the end of a track would damage very valuable property, as for example, an expensive building.

Mr. J. S. Robinson (C. & N. W. Ry.) spoke of the concrete bumpers he had used. They were 6 or 7 ft. long and mounted about 3 ft. high. In several collisions of freight cars with them the bumpers had been slightly chipped off, but had been readily patched up and made good as new.

Mr. Willard Beahan (L. S. & M. S. Ry.) described a method of reducing the shock transmitted to the car by a bumper. It consisted in placing timbers on each side of the rails a short distance ahead of the bumper and filling the space between the timbers with sand to a height of ½ in. above the rails.

Mr. B. J. Sweatt (C. & N. W. Ry.) suggested as a substitute for the bumping post in ordinary cases, that the rails be elevated 2 ft. in 30 ft. near their extremities and be covered with gravel.

PILE AND FRAME TRESTLE BUILDING.—The committee on this subject, of which J. P. Canty (B. & M. R. R.) was chairman, limited their circular of inquiry to the following questions:

1. Do you at present, or is your road planning to, treat trestle timber with a preservative?
2. Is it your practice to cover tops of stringers and caps in open pile and frame trestles with any liquid preparation, roofing material, or sheet metal to prevent timber from rotting? If so, please describe method used and give your opinion of the value of the protection.
3. Do you enclose piles or posts with a casing near ground line or in water to preserve same from attack of insects? If so, please give description of arrangement.
4. What precautions, if any, do you take to protect timber trestles from fire?
5. Have you any trestles in use with solid timber floors covered with ballast? If so, please give sketch showing construction, if possible, or a full description of this design.
6. Please give your opinion from a maintenance standpoint of merits and demerits, if any, of solid floor trestles covered with ballast.
7. How often do you have timber trestles inspected? Please describe fully your method of inspection.

The replies received in answer to Question 1 showed 36 not treating their trestle timber with a preservative, although many of them are contemplating doing so on account of the present high prices of timber. There were 17 who reported as having tried different methods, the usual one being the use of creosoted timber, which had been found to give excellent results, although the increase in cost was about 75%. Carbolineum Avenarius had been used by a few of those who replied, in places where the timber comes in contact with earth or with other timber so as to cause decay.

In answer to Question 2 the large majority reported negatively. Those who did protect the parts mentioned, used a prepared paint, white lead or tar, Carbolineum Avenarius, and in some cases a galvanized iron or sheet zinc covering.

The majority of answers to Question 3 were also negative, although in many of these cases there was no trouble from insects. Those who reported as using a protection favored creosoted piles both as a protection from rot and from the teredos in salt water; for preserving steel posts in water a concrete casing was recommended.

Most of those who answered Question 4 use water in buckets and pails which are set alongside the bridge floor. In the majority of cases special attention is paid to keeping weeds and all rubbish away from the trestles. In a few cases watchmen are employed, fireproof paint used, or the caps and stringers are covered with galvanized iron.

The majority of answers to Question 5 were in the negative; of the 53 replies received 39 were unfavorable to or did not use solid timber floors covered with ballast.

The answers to Question 6 were about equally divided for and against the maintenance of solid floor trestles covered with ballast. Those who wrote favorably of it stated that this form of construction protected the timber from fire, and that noise was thereby eliminated. Those who wrote to the contrary claimed that such structures were difficult to inspect and repair, and that the ballast holds dampness and thus produces rot in the tops of the stringers.

The inspection of timber trestles, according to the answers to Question 7, is usually made twice a year by the bridge superintendent, and from 6 to 12 times a year by the division inspector. The method of inspection is in the majority of cases by boring with a small bit, although the hammer or pick is used by some.

In discussion, Mr. J. S. Robinson (C. & N. W. Ry.) remarked that he considered a gravel deck trestle the best. He described one that had been in service 12 years without repairs. The piles and caps were creosoted, but not the stringers nor covering planks. The latter were covered with rubberoid paper, asphaltum, and gravel. The cost of this construction was $12 per linear foot with timber costing $8 per 1,000 at the mills or $22 per 1,000 delivered.

Mr. J. H. Cummin (L. I. R. R.) stated that only creosoted piles should be used in salt water where the teredo is present. He cited a case where these insects had severed yellow pine 8 × 10 ins. in 10 mos. The cleaner, deeper, and warmer the water, the larger the size of the teredos and the more rapidly do they attack the wood.

Mr. R. H. Reid (L. S. & M. S. Ry.) found that fir stringers after 10 years' service were 99% as good as when put in. All the care they require is that necessary to keep their surface clean and free from dirt. He believed that high-grade yellow pine would soon become so prohibitively high in cost that fir stringers would have to be used.

The importance of the subject of pile and frame trestle bridges was considered sufficient to warrant continuing this topic on the standing subject list.

DISCUSSION ON CONCRETE CONSTRUCTION—Three reports on concrete construction were listed on the program, but not one of them was in readiness for presentation. The respective subjects for these reports were: "Concrete Bridges, Arches and Subways"; "Experience and Use of Concrete and Timber Piles"; and "Concrete Building Construction." The discussions on them were particularly full, as previously mentioned, and became so animated that the topic was placed, by a unanimous vote, on the standing subject list. Abstracts of the discussions are given herewith:

Mr. R. H. Reid (L. S. & M. S. Ry.) opened the discussion by describing some concrete work done on his road. He said he had found that for heavy traffic, concrete could be put in much cheaper than stone; that stone could not be handled so as not to interfere with the traffic. For heavy construction he used concrete composed of 1 part cement, 3 parts sand, and 6 parts crushed stone. All large structures are reinforced with steel rods, those of the twisted type giving the best results. Every car-load of cement, they used, was first tested by their chemist, but not over 1% had been rejected. To allow for expansion and contraction, they introduced two V-shaped joints every 250 ft. Some of the members present did not think expansion joints were necessary in concrete work, claiming they had had experience with long stretches without joints in which no cracks had resulted from contraction or expansion. Others, however, had noted a movement of ⅜ in. in a 40-ft. length of non-reinforced concrete. The majority of those present favored the use of expansion joints. In cold weather, concrete requires a longer time to set. In small structures the forms were usually taken off after 1 week, and in large structures after 2 months.

In answer to a question from Mr. W. M. Clark (B. & O. R. R.) as to whether a solid concrete ash pit would stand heat, Mr. Reid replied they had in use a 4-in. concrete ash pit and had experienced no trouble from the heat in the ashes.

Mr. Clark stated that concrete work could be successfully carried on in cold weather if the frames were left on until the concrete was thoroughly dried. If concrete is mixed wet and kept wet it will not crack afterward, but if mixed dry it will crack.

Mr. W. E. Alexander (B. & A. R. R.) mentioned the fact that the effect of the sun in summer on concrete is as bad as that of a hot fire, and in consequence it is necessary not to let the concrete dry out until the entire structure is up.

Mr. Reid stated that owing to the vibrations of railroad trains the matter of reinforcement is entirely different from that in the case of building. Because of the greater grip on the concrete afforded by twisted or corrugated iron bars, they should be used in place of plain bars for reinforcing railroad structures.

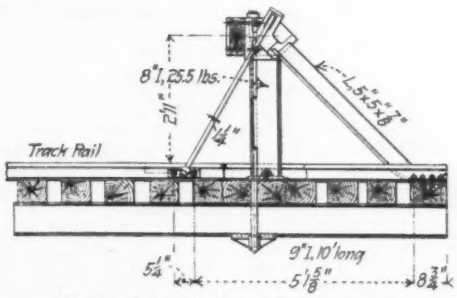


Fig. 3. The Gibraltar Bumping Post.

Mr. J. H. Cummin (L. I. R. R.) said there were several concrete buildings in use on the L. I. R. R., and that so far they had proved very satisfactory. He referred to certain cases, however, where the walls of concrete buildings had collapsed due to the use of too large a proportion of sand in the concrete.

Concrete whistling posts were described by Mr. Reid, who said they had a number in use on the L. S. & M. S. Ry. These posts are made in a mold and the concrete is reinforced by a very small rod or wire. The letters are countersunk in the post and painted black. Concrete fence posts were also described by Mr. Reid. These posts are of uniform size, 5 × 5 ins., and reinforced with four ¼-in. rods. At distances of 4 or 5 ins. along the post, single wires are introduced to hold the woven-wire fence used. The posts, placed, cost 44½ cts. each.

DISCUSSION ON PRESERVATIVES FOR WOOD.—The report presented on the preservatives for wood was rather meager, but the discussion on this subject was quite extended and interesting.

Mr. R. H. Reid (L. S. & M. S. Ry.) said the preservative used on the road he represented was Carbolineum Avenarius. This was applied with a brush. In summer it could be used in its natural state, but in winter it must be heated to make it flow easily. He considered creosote the best preservative, but on account of the time required to apply it and the limited quantity of timber that could be treated at one time, Carbolineum Avenarius had been used in its place. The latter was employed on bridges in place of paint, and was preferable to paint because it enabled the sap to dry out, whereas paint retained the sap inside and thus caused dry rot. It also was not an expensive preservative, whereas 3-in. pine, creosoted, cost about double that of ordinary pine plank and required 8 months to get it.

Mr. W. F. Steffens (S. & W. Ry.) advised painting railroad ties on only three sides, as they would last longer with the bottom side unpainted.

Mr. J. F. Parker (S. C. Ry.) used crude oil as a preservative for wood. He found that it prevented checking, kept water from getting in, improved the appearance, and about doubled the life of the timber. He would not admit that it increased the fire risk. The oil used for the purpose cost only 18 cts. per barrel. No regular practice was made by the road he represented, of repainting to compensate for evaporation or drying of the oil.

A COMPARISON OF UNIVERSITY AND INDUSTRIAL DISCIPLINE AND METHODS.*

By Frederick W. Taylor, M. Am. Soc. M. E.†

The point from which I view college education is that of the employer, not that of the educator. And in what I shall say I have principally in mind the preparation of young men for success in commercial engineering and industrial enterprises.

Let me say at the start, that without question, our college graduates as a class represent the finest body of men in the community. Within a few years after graduation the college educated engineer far outstrips in position and salary his average competitor who comes up from the ranks.

It would be a much more congenial task to dwell upon this view of the profession, but something may possibly be gained by considering what has seemed to many of the friends of our young graduates to be the one defect which they practically all have in common.

For a period of from six months to two years after graduating they are, generally speaking, discontented and unhappy. They are apt to look upon their employers as unappreciative, unjust and tyrannical, and it is frequently only after changing employers once or twice and finding the same lack of appreciation in all of them, that they finally start upon their real careers of usefulness.

On the other hand, the attitude of employers towards young graduates is fairly expressed by the following written instructions given for the selection of quite a large number of young men to fill positions which presented opportunities for rapid development and advancement. These instructions were to give the preference—first, to graduates of technical schools; second, to the graduates of the academic departments; but to employ no college boy who had not been out for more than two years.

Why is it, then, that these young men are discontented and of practically little use during the first year or two after graduating?

To a certain extent this is unquestionably due to the sudden and radical change from years spent as boys almost solely in absorbing and assimilating knowledge for their own benefit to their new occupation of giving out and using what they have for the benefit of others. To a degree it is the sponge objecting to the pressure of the hand which uses it. To a greater degree, however, I believe this trouble to be due to the lack of discipline and to the lack of direct, earnest and logical purpose which accompanies, to a large extent, modern university life.

During the four years that these young men are at college they are under less discipline, and are given a greater liberty than they have ever had before or will ever have again.

As to college discipline, it cannot be a good training for after life for a young man deliberately to be told by the university authorities that he can flagrantly neglect his duties sixty times in one term before any attention will be paid to it; while, if in business, the same young man would be discharged for being absent two or three times without permission.

And, as to the freedom offered by the modern university system, it is not true that boys from eighteen to twenty years old have the knowledge and experience necessary to select a logical, and well-rounded course of studies, and even if they had this wisdom, the temptation to choose those studies which come easiest is so strong that it would be unwise to throw upon them so great a responsibility. Nor does it appear wise to leave each student free to study as little or as much as may

*From an address delivered at the dedication of the new Engineering Building for the University of Pennsylvania.

†President of the American Society of Mechanical Engineers, Highland Station, Chestnut Hill, Philadelphia.

suit him, at times doing practically no work for days, and at others greatly overworking, with no restraint or direction except the round-up which comes twice a year with examinations. At the least, it must be said that in commercial or industrial life this undirected liberty will never again be allowed them.

During the past thirty years two radical changes have occurred in educational methods. The kindergarten and its accompanying ideas has come for the children, and for the young men has come the change from the college, with its one or two courses carefully selected and rigidly prescribed by the faculty, to the university with as many different courses as there are young men, and in which under the elective system each student is given the choice of all of his studies.

The fundamental idea back of the change from college to university is excellent; namely, that of providing a far greater variety in the courses to suit the different tastes and abilities of the students, and to especially prepare them for their future occupations. Accompanying, however, this great step in advance, and yet, so far as I can see, in no way logically connected with it, has come the false step of giving our young men in many ways a greater liberty than is allowed, on the whole, to any other class of active workers; and of handing over to them the final decision in a subject most needing a master mind.

Commercial, manufacturing and other enterprises in which many men cooperate, are managed more and more by delegating all important decisions to a few men whose judgment has been trained through long experience, study and observation in those matters which they are called upon to decide. Yet many of our universities are managed by giving over to the young man, under the elective system, the final decision as to what studies will best fit him for his life's work, although he has, of necessity, but the vaguest idea of the nature of the subjects which lie before him. It is almost like asking him to lift himself up by his boot straps.

The kindergarten also, which has proved so great a help in training the younger children, making them observant and giving them a certain control over themselves, has brought with it one idea which has wrought great harm, and yet this bad idea is in no way properly or logically connected with the underlying principles of the kindergarten.

Somehow the average kindergarten child gets a firm conviction that it is the duty of the teacher to make things interesting and amusing, and from this follows soon the notion that if he does not like his studies and fails to learn much, it is largely the teacher's fault. Now, whatever views the parents or the teachers themselves should hold upon the duties of teachers, there is no doubt that the boys should have firmly in their heads the good old-fashioned idea that it is their duty to learn, and not that it is the duty of the teacher to teach them.

Along with the kindergarten plan of interesting and amusing children, the idea has taken firm hold in a large portion of the educational world that the child and the young man should be free to develop naturally, like a beautiful plant or flower. This may again be an excellent view for the older person to hold, but it is a distinctly bad one for the young man to act upon. He promptly translates the idea of developing naturally into wishing to do only, or mainly, those things which he likes or which come easy to him.

Of all the habits and principles which make for success in a young man, the most useful is the determination to do and to do right all of those things which come his way each day, whether they are agreeable or disagreeable; and the ability to do this is best acquired through long practice in doggedly doing along with that which is agreeable a lot of things which are tiresome and monotonous, and which one does not like.

Now neither the kindergarten idea, the university elective system, nor the lax college discipline tend to develop this all important habit in young men.

We must remember that of all classes in the community, college boys are being trained to fill some day the position of leaders in the co-operative field. And there is no fact better established than that the man who has not learned promptly and fully to obey an order is not fit to give one.

The successful men of our acquaintance are, generally speaking, neither learned nor men of great intellect. They are men, first of all possessed with an earnest purpose. They have a certain all-round poise or balance called common sense. They have acquired through long training those habits both mental and physical which make them masters over themselves; and at all times they have the firm determination to pay the price for success in hard work and self-denial.

It is singleness and earnestness of purpose that constitutes the great motive power back of most successful men, and it is a notable fact that the moment a young man becomes animated with such a purpose, that moment he ceases to believe in the elective system, and in the loose college discipline.

Is not the greatest problem in university life, then, how to animate the students with an earnest, logical purpose?

In facing this question I would call attention to one class of young men who are almost universally imbued with such a purpose; namely, those who, through necessity or otherwise, have come into close contact and direct competition with men working for a living. These young men acquire a truly earnest purpose. They see the reality of life, they have a strong foretaste of the struggle ahead of them, and they come to the university with a determination to get something practical from the college training which they can use later in their competition wih men.

They are in great demand after graduating, and as a class make themselves useful almost from the day that they start in to work.

Neither their earnestness of purpose, however, nor their immediate usefulness, comes from any technical knowledge which they have acquired while working outside of the university, but rather from having early brought home to them the nature of the great problem they must face after graduating. Nothing but contact with work and actual competition with men struggling for a living will teach them this. It cannot be theorized over or lectured upon, or taught in the school-workshop or laboratory.

I look upon this actual work and competition with men working for a living as of such great value in developing earnestness of purpose that it would seem to me time well spent for each student, say, at the end of the Freshman year, to be handed over by the university for a period of six months to some commercial, engineering or manufacturing establishment; there to work as an employee at whatever job is given him, either manual or other work. He should have the same hours and be under the same discipline as all other employees, and should receive no favors. Moreover, he should be obliged to stay even a longer time than six months unless he has in the meantime given satisfaction to his employers.

Unfortunately, laboratory or even shop work in the university, useful as they are, do not serve at all the same purpose, since the young man is surrounded there by other students and professors, and lacks the actual competition of men working for a living. He does not learn at college that, on the whole, the ordinary mechanics, and even poorly educated workmen, are naturally about as smart as he is, and that his best way to rise above them lies in getting his mind more thoroughly trained than theirs, and in learning things they do not know. All of this should be taught him through six months' contact with workingmen.

Let me repeat in conclusion that our college graduates are the best picked body of men in the community. eYt I believe that it is possible to so train young men that they will be useful to their employers almost from the day that they leave college; so that they will be reasonably satisfied with their new work instead of discontented; and to place them upon graduating one or two years nearer success than they now are; and that this can best be accomplished by giving them an earnest purpose through six months' contact early in their college life with men working for a living; by rigidly prescribing a course of studies carefully and logically selected, and with some definite object in view, and by subjecting them to a discipline comparable with that adopted by the rest of the world.

ANNUAL CONVENTION OF THE MUNICIPAL TRAMWAYS ASSOCIATION (GREAT BRITAIN).

The Municipal Tramways Association is an English organization composed of the officers and representatives of street railways owned and operated by municipalities, and its fifth annual convention was held at Leeds, England, on Sept. 19 to 21, 1906. About 150 members and visitors were present, the former representing more than 50 towns and cities. The annual address was delivered by the President, Mr. J. B. Hamilton. He stated that the Board of Trade returns for 1905 show that about $165,000,000 have been expended by local authorities in street railway undertakings. There are 174 of these undertakings (aggregating 1,395 miles), and 115 are municipally operated, the capital expenditure being about $142,500,000. The gross receipts for the 115 lines were about $30,000,000, while the number of passengers carried at 2 cts. each was 1,355,000,000. The company and municipally-owned and operated street railways aggregate 2,116 miles of line, with a capital expenditure of $268,750,000, gross receipts of $50,000,000, and 2,068,000,000 passengers. Mr. Hamilton did not think that the motor omnibus would permanently affect street railway development, in spite of the very extensive use of these vehicles in London. In two cities a parcels or express service has been instituted, but the conveyance of h[illegible] freight has not yet received serious consi[illegible]tion.

MUNICIPAL STREET RAILWAY OPE[illegible]TION.—This paper was by Mr. R. A. Sim[illegible] a member of the Leeds Corporation Tra[illegible] Committee, and dealt with the policy to be [illegible] served by committees of this kind. One se[illegible] difficulty is that of getting men of high bus[illegible] capacity to accept a nomination and if elect[illegible] to give the necessary time to their public d[illegible]s. The paper was followed by a lengthy discu[illegible]n, but this had little relation to engine[illegible]g matters.

STREET RAILWAY BRAKES.—In thi[illegible]a-per, Mr. Henry Mozley, General Manager [illegible]the Burnley municipal street railways, describ[illegible] the experience with brakes on lines having num[illegible]us steep grades (10% and 8%). Double-deck [illegible]rs are used, mounted on Brill maximum-tra[illegible]tion trucks, and seating 70 passengers; they [illegible]igh 12½ tons empty and about 17½ tons load[illegible] It was considered that mechanical track b[illegible]kes should be used, and experiments were made [illegible]with a brake specially designed for the purpose; [illegible]ese experiments showed that wood was not saf[illegible] for the slipper blocks and blocks of soft grey cast-iron were found to be the best. About the same time experiments were made with magnetic brakes of two designs, the Newell and Westinghouse. The results were not satisfactory, especially in regard to destructive effects upon motors and the burning out of armatures. The mechanical brake was therefore adopted and is found to stop the car in 10 or 12 ft. when descending a 10% grade at six miles an hour. The cast-iron shoes or blocks are 3 × 15 ins., with a wearing depth of 1⅛ ins., and last from 10 to 21 days, according to the weather. The wear of rails after 2½ years' service and the passage of 81,655 cars was very slight. Mr. Mozley presented the following conclusions based on his experience:

1. Cars with trucks are easier to control on steep inclines than four-wheel cars, whatever the character of the brakes.
2. Magnetic brakes, particularly those which affect the wheel brakes, are unsuitable for street railways, either for service or emergency purposes. They can only be considered as auxiliary to the rheostatic brake and not as independent track brakes. They are highly destructive to the motors, and are treacherous and uncertain in their action.
3. The only forms of brakes which will safely control a car on grades greater than 6 or 7% are: (A) Hand brake with adequate leverage operating cast-iron shoes on the wheels; (B) mechanical track brake with adequate leverage provided with cast-iron slippers; (C) rheostatic brake for emergencies only.

In opening the discussion, Mr. A. L. C. Fell (London County Council Tramways) pointed out that Mr. Mozley's experiments with magnetic brakes were made in 1903, and that great improvements have since been made. The magnetic brake has been adopted for the heavier London cars, and the united vertical pull on the rails by the four magnets is 18,000 lbs.; it is operated as the regular service brake, so that the men are quite accustomed to its use. Mr. Nance (Belfast street railways) prefers the hand brake for service use in controlling and stopping the car, but this is supplemented by a track brake or slipper brake on steep grades. Mr. Aldworth, General Manager of the Nottingham street railways, has used magnetic brakes with success, and considered wooden shoes or slippers satisfactory. In closing the discussion, Mr. Mozley suggested that the London lines might have a less favorable opinion of the magnetic brake after it has been in use for a sufficient time to develop its reliability and its cost of maintenance.

A paper on "Street Railway Track Work" was then read by Mr. R. C. Bullough, General Manager and Engineer of the Colchester street railways, and we shall publish an abstract of this, together with the discussion, as it deals with a matter of growing importance in this country. The last paper was on "Depreciation and Renewal Funds in Relation to Street Railway Undertakings," by Mr. G. W. Holford, General Manager of the Salford municipal street railways.

An attempt has been made to effect an amalgamation of this association with the Tramways

and Light Railways Association and the Association of Tramways Officials; the executive committee submitted a report in favor of such action, but the meeting adopted a resolution to the effect that it would not be advisable to proceed further with the matter. The election of officers resulted as follows: President, J. M. McElroy, General Manager of the Manchester street railways; Vice-President, I. Aldworth, General Manager of the Nottingham street railways; Secretary and Treasurer, A. F. Fearnley, General Manager of the Sheffield street railways.

THE NEW ENGINEERING BUILDING OF THE UNIVERSITY OF PENNSYLVANIA.

A new building for the Engineering Department of the University of Pennsylvania was formally dedicated on Oct. 19 and is with little doubt the finest, largest and best equipped structure devoted to instruction in engineering in the United States, if not in the world. The formal exercises in connection with the dedication of the new building were held in its auditorium on the afternoon of Oct. 19 and were attended by a large number of invited guests representing the principal engineering schools of the country. The keys of the building were formally presented to Hon. Chas. C. Harrison, Provost of the University, by Mr. Emlyn L. Stewardson, of the class of 1884, on behalf of the architects of the building, Messrs. Cope & Stewardson.. The honorary degree of Doctor of Science was then conferred by the Provost on a number of distinguished engineers, including the presidents of three national engineering societies: Mr. Frederic P. Stearns, of the American Society of Civil Engineers; Mr. Frederick W. Taylor, of the American Society of Mechanical Engineers; and Prof. Samuel Sheldon, of the American Institute of Electrical Engineers. The same degree was conferred upon Gen. Alexander Mackenzie, Chief of Engineers of the U. S. Army; Admiral Charles Whiteside Rae, Chief of the Bureau of Steam Engineering of the U. S. Navy; Prof. Mansfield Merriman, for 28 years Professor of Civil Engineering at Lehigh University; M. Ramon Ivarrola, the official representative of the Mexican Government at the dedication; Mr. Samuel M. Vauclain, Superintendent of the Baldwin Locomotive Works; Prof. H. W. Spangler, head of the Department of Mechanical Engineering of the University; Prof. Edgar Marburg, head of the Department of Civil Engineering of the University; and the venerable John Fritz, the Nestor of the iron and steel industry of the United States. Following the conferring of these degrees, a portrait of the late J. Vaughan Merrick was presented to the University. The remainder of the dedication exercises was occupied by two addresses: the first was given by Mr. Frederick W. Taylor, comparing the discipline and methods of the University and of industrial establishments; and the concluding address was by Mr. Alexander C. Humphreys, President of Stevens Institute of Technology, on "The Engineer as a Citizen." The remainder of the afternoon was devoted to examination of the new building, a full description of which is given below.

In the evening a dinner was given at the Union League Club by the alumni of the Engineering Department. A large number of invited guests were present, and the total number seated at the tables was about 300.

The history of the Engineering Department of the University of Pennsylvania dates back to 1852, but the growth of the department was slow until some 20 years later, when a new building was constructed for the mechanical and electrical engineering departments. The rapid growth of all departments in the engineering school, however, soon overtaxed the facilities provided, and some five years ago plans were matured for the completion of the present new building. In its construction the experience of engineering institutions the world over has been sought and made use of, and it is believed to be a model in every respect for the work to be performed. A detailed description of the building is as follows:

The building has a frontage of 300 ft., with a depth of 210 ft. at one end and 160 ft. at the other. There are three stories, with a basement covering about one-third of the entire building. The total floor area is 128,000 sq. ft. The foundations are of concrete carried 28 ft. below the lower level. Steel construction is used throughout. The floor arches are of hollow tile. The floors are of hard pine, excepting those in the halls, which are finished in marble and those in the laboratories which are of concrete.

The exterior of the building is of dark colored brick with limestone trimmings, and the general architectural treatment, as shown in the illustration on the next page, is in the English-Georgian style. For the roof, steel trussed girders with a slate covering are used. The approximate cost, including equipment, was about $1,000,000.

The building is heated by steam, each room being fitted with steam coils supplied by exhaust steam from the central station. The ventilation is by electrically-driven fans, located in the attic and in the basement. The ventilating system is divided into sections, each with a separate fan and tempering coils, so that only that portion of the building in use has fresh air pumped into it. The fans may be controlled from any room in the building. The lighting is by electricity.

The basement contains the machinery for heating and ventilation, locker rooms, lavatories, the storage battery rooms, laboratories for geodetic and hydraulic work and for the testing of materials of construction. On the first floor, adjacent to the main entrance, are the offices of the heads of departments, the east end of the building being devoted entirely to the Civil Engineering Department, and the west end to the Mechanical Engineering Department. On the second floor a reference library, capable of holding 20,000 volumes, and a reading-room occupy the central space at the front of the building. The library is flanked on either side by a series of recitation and lecture-rooms. There is also a students' assembly-room with about 2,500 sq. ft. of floor space. At the rear are the drawing-rooms, the alternating-current laboratory, and the repair shop. On the third floor is a large room for the engineering societies, a general supply store, class rooms, instructors' rooms, drawing-rooms and a large room for an engineering museum.

Two principal entrances lead to the main hallway, which extends east and west the entire length of the building, with staircases at both extremities. Two large light-wells terminate in skylights over the ground floor.

A feature of the laboratory equipment worthy of note is the practice, wherever possible, of providing separate apparatus for individual students. Each man is thus enabled to work alone and be held responsible for the results turned in by him; also for the apparatus assigned to him. In cases where this plan would not be feasible, as, for example, in obtaining the steam consumption of an engine, one student is the leader and another the helper at one laboratory period; at the next laboratory period the student who formerly was the helper then assumes the leadership, running a test on the same engine but under different conditions. In each case the leader is responsible for the test, and the observations taken belong to him. Each student is thus obliged to work up a complete set of observations and, in consequence, the results are the same as if each man were making the test alone.

In the laboratories, one instructor is provided for about every eight students. Owing to each student being advised some time beforehand as to the apparatus that will be at his command, the systematic outlining of the experiments on advance sheets, and the access to the engineering library in the building, the ratio of 1 to 8 undoubtedly gives better results than could otherwise be expected.

THE CEMENT LABORATORY.—The cement laboratory occupies a floor space of about 1,700 sq. ft., and is divided into two parts, the larger part being devoted to testing cement, and the smaller part to concrete work and experimental research.

The larger room contains four large slate-top mixing tables, each fitted with a damp-closet, locker and drawers, and two balances. The waste is discharged through chutes conveniently located. Graduated burettes are mounted on these tables through which water at normal temperature can be accurately and quickly obtained. The testing apparatus consists of an Olsen and a Riehlé lever machine, electrically driven, a Fairbanks and a Falkenau-Sinclair machine, and a 50,000-lb. hand-power hydraulic machine for compression tests. This room also contains an Olsen mechanical briquette-molding machine, a Howard & Morse automatic sifting apparatus for sand and cement, and a Bauschinger expansion apparatus. Nine soapstone immersion tanks, subdivided, piped for the hot and cold water, and fitted with overflow discharge connections, enable a continuous flow of water to be maintained at any desired temperature. One of these tanks is supplied with zinc racks for the storage of small briquettes. A large soapstone damp-closet is provided for large briquettes and beam molds.

The smaller room contains a mixing table, boiling apparatus for accelerated tests, a drying oven for use in specific gravity and absorption tests, and a large concrete immersion tank capable of accommodating concrete beams 13 ft. long. A beam crane is used for the convenient handling of the beams and their transference to a carrying frame mounted on casters, which latter is used to convey them to a 200,000-lb. Olsen testing machine across the hall. This testing machine is fitted with a beam extension 15 ft. long, designed for a working load of 120,000 lbs. It is operated by a direct-connected 5-HP., two-speed electric motor, and is equipped with an autographic attachment for recording stress-deformation diagrams. The entire equipment of the cement laboratory was the gift of Mr. Robert W. Lesley.

THE TESTING MATERIALS LABORATORY.—The laboratories for testing materials other than cement occupy a floor area of about 3,300 sq. ft. Two rooms in the basement and one room on the first floor are devoted to this purpose. The floor of the latter is of massive reinforced concrete construction, supported on steel beams and designed for a working load of 500 lbs. per sq. ft.

The largest machine to be used for testing has a capacity of 600,000 lbs. It is an Olsen, vertical four-screw machine of the universal type, capable of receiving a column 24 ft. long, and is provided with beam extensions below the floor level 21 ft. long designed for a load of 200,000 lbs. on a span of 20 ft. This machine is under contract but not yet installed.

The testing equipment comprises, in addition to the above, a 200,000-lb. Olsen machine, a 100,000-lb. Olsen machine, two 30,000-lb. Olsen machines, one 30,000-lb. Falkenau-Sinclair machine, one 60,000-in.-lb torsion machine, an autographic pendulum torsion machine of the Thurston-Riehlé type, a 10,000-lb. transverse machine, a cold-bend machine capable of bending a steel bar 1 sq. in. in section, and a 15,000-lb. wire-testing machine. With the exception of the transverse, the wire-testing, and the pendulum torsion machines designed for hand operation, all of these machines are electrically driven by independent motors.

Extensometers, compressometers and shearing apparatus are also installed, and a small room in the basement contains two rattlers for testing paving bricks, which may be operated singly or jointly by an electric motor. For the preparation of test specimens and for the construction and repair of apparatus, a well-equipped machine shop is provided in the basement.

THE GEODETIC LABORATORY.—A spacious, well-lighted room in the basement, entirely above the ground level, is devoted to this work. The surveying instruments are stored in this room, and piers and large tables are provided for indoor work, especially during inclement weather. The equipment consists of a large assortment of instruments used in ordinary engineering practice, and a variety of instruments of greater precision for geodetic surveying.

THE HYDRAULIC LABORATORY.—About 6,300 sq. ft. of floor area are devoted to hydraulic

work, there being a spacious room in the basement, one directly overhead on the first floor, and a small room on the second floor, occupied by the testing apparatus.

A circular, vertical, steel pressure tank 5½ ft. in diameter and 37 ft. high extends from the basement floor to the second-story ceiling. This tank is provided with orifice devices designed to permit of changes in the orifice plates while the tank is under pressure. The maximum working pressure is 65 lbs. per sq. in., corresponding to a head of 150 ft. The piping is so arranged that the tank can be brought under the pressure of the city water mains, under the pressure of the water in a stand-pipe extending a few feet above the roof of the building, or under higher pressures by direct pumping.

The pressure tank discharges into one of a pair of reinforced concrete tanks each 34 ft. long and 5 × 5½ ft. in cross-section. Perforated pipes and baffle screens are used to break up the current. The two tanks are connected by a sluice gate so that they may be used jointly as a single calibrated measuring tank of 13,000 gals. capacity. The arrangement of the weir plates at the extremities of these tanks is such that weirs with and without end contractions may be obtained, as well as discharges through orifices under low heads. The lowest end plates are hinged, and by swinging these plates down, the tank may be converted into a canal across which dams of different profiles may be placed for investigations on the flow over dam crests.

The weirs discharge into a reinforced concrete reservoir of 23,000 gals. capacity, and provision is made for weighing the discharge before it passes into this reservoir. From the reservoir the water is pumped by three Worthington 4-in., two-stage pumps each driven by a 35-HP. electric motor. Each pump has a capacity of 450 gals. per min. against a maximum head of 165 ft.

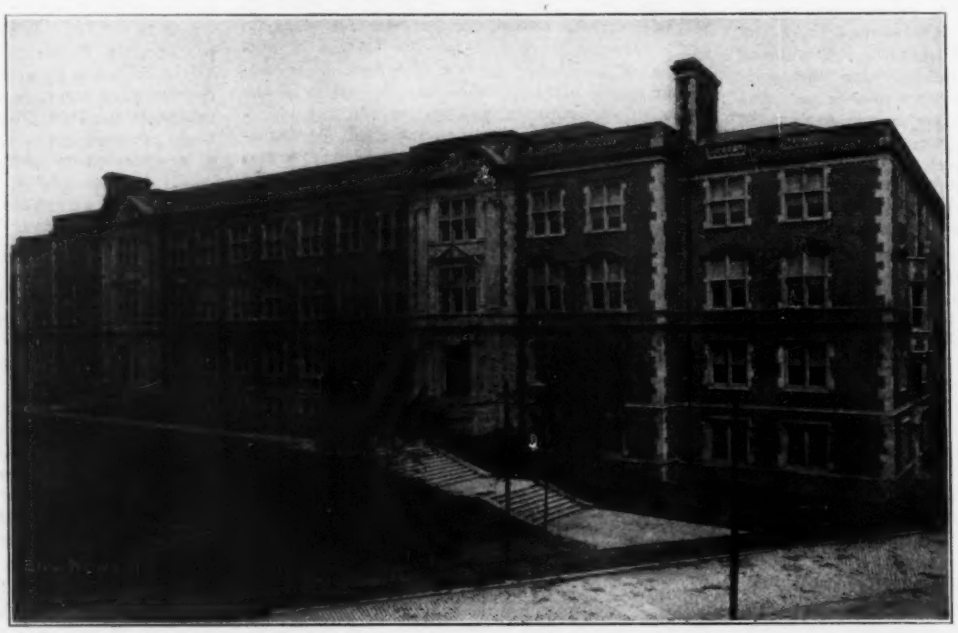
An important feature of this laboratory equipment is a stand-pipe 12 ins. in diameter and 65 ft. high, extending from the basement floor to a short distance above the roof of the building, and connecting with the main pipe circuits and with the pressure tank at top and bottom. Circular overflow weirs are provided at frequent intervals in the stand-pipe for testing apparatus under a constant static head of predetermined height up to 65 ft. For greater pressures connection is made with the pressure tank. An 8-in. tubular well 110 ft. deep is also provided for efficiency tests and experiments with air lifts and deep well pumps. The laboratory is equipped with a 9-in. turbine and a 12-in. reaction wheel, suitably mounted for efficiency tests; also with an excellent assortment of water meters and a great variety of minor apparatus.

THE MECHANICAL LABORATORY.—The total floor space devoted to mechanical laboratory purposes is 14,000 sq. ft. on the ground floor. This space is occupied by a standard room, a boiler plant, testing floor, a producer room, gas engine laboratory, heating room, refrigerating room, steam laboratory, dynamometer laboratory, hydraulic testing apparatus, and the apparatus already described for testing materials.

The steam, exhaust, and water piping is run overhead. Steam at 100 lbs. pressure is supplied from the University central light and heat station, the exhaust piping also connecting into the general exhaust system. Power outlets are distributed throughout the laboratory for the various motor drives. The main lighting is done by arc lamps suspended from the ceilings, with outlets at convenient points for the connection of portable lights. Three runways, with travelers and chain hoists, provide facilities for handling the heavier machine parts.

The boiler testing plant contains a 100-HP. Roberts water-tube boiler, a Wainwright feed heater, and a Worthington duplex feed pump, together with the necessary weighing tanks, etc. The whole plant can carry steam at 250 lbs. per sq. in., the steam line leading over the testing floor which is of iron plate 13 × 12 ft., with water, steam and exhaust outlets at disposal. A Wheeler cooling tower, a row of gas engines ranging in size from 3 HP. to 30 HP., and a 1-ton ammonia ice machine with refrigerating chamber and ice tanks, are also provided. Space has been left for a gas engine to be run directly from a suction producer that will later be installed.

A very complete line of engines, condensers, injectors, etc., constitutes the steam laboratory. In the dynamometer laboratory are two belt-driven dynamometers and a railroad oil tester. For hydraulic work in the mechanical laboratory, tanks are provided for water meter calibration, and for nozzle calibration. Pump tests are made on a 2-in. centrifugal pump, and there are three water-wheels: a Doble impulse wheel, a Pelton wheel, and a Leffell reaction wheel, mounted respectively on three flume tanks. In addition to the above there are two Ericsson hot-air engines and a Deming motor-driven triplex pump; also an instrument room used for coal calorimetery, gas analysis, gage calibration, indicator and planimeter examination, and micro-photographic work.



THE NEW ENGINEERING BUILDING OF THE UNIVERSITY OF PENNSYLVANIA, DEDICATED ON OCTOBER 19.

THE ELECTRICAL LABORATORY.—Five rooms are devoted to electrical work. In every case provisions are made so that one experiment may be carried on entirely independent of every other one. The five rooms are devoted respectively to instrument testing, direct-current machine testing, alternating-current machine testing, and two rooms to photometry.

The instrument room has a floor area of 4,500 sq. ft., part of which is enclosed for an apparatus room, instructors' offices, and a storage battery room. It is on the ground floor and nearly all under skylight. There is a table and a galvanometer pedestal for each student, 24 students in all being provided for. The tables consist of two concrete pillars, each about 2 ft. high, and carry a slate slab 26 × 44 ins., and 1½ ins. thick. The pedestals are located immediately in front of the tables, and are built of one large concrete pillar capped with a slate slab 15 × 44 ins., and 1½ ins. thick. They are of the same height as the tables. This method of construction reduces vibration to a minimum.

There are four marble switchboards with wires running to each of the tables just mentioned. All the wiring is rubber covered and runs below the floor level in concrete drains covered with rolled-steel floor-plates. Each switchboard is fed by a battery of 80 storage cells and also with 110 volts from the dynamos. Either alternating or direct current is available from the switchboards, and as a source of energy for elementary work, about 25 primary batteries are provided.

For direct-current machine testing there is utilized about 2,000 sq. ft. of space on the ground floor. The machines are placed upon raised concrete foundations from 4 to 8 ft. square. The foundations are approximately 6 ins. in height, and on top of them are placed wooden runners of 3 × 4-in. yellow pine at a distance of about 6 ins. apart. On top of these wooden pieces are iron straps laid at right angles to them. The irons are screwed to the wood, which is bolted to the concrete. The machines rest upon the iron strips, and the vibrations produced by the machines are taken up in the wood. A slate terminal board is placed at each test stand, and on this 500 amperes are available at 110 volts; also battery current at 6 to 150 volts.

The alternating-current machine testing occupies about 2,100 sq. ft. on the second floor; this space, however, includes the photometer rooms. A 4-KW. Wagner alternator, a 1-KW Westinghouse alternator, a 2-KW. Westinghouse alternator and a 1-HP. Holtzer-Cabot alternating-current motor, together with a 14-ft. switchboard thoroughly fitted, and about 90 measuring instruments, comprise the equipment. The photometer rooms have dull black walls and labyrinth entrances. A storage battery of 76 cells furnishes current for photometer work. Each room has a photometer with a 3-meter track and universal rotating stand. One photometer is equipped with a Lummer-Bodhun screen and one with a Bunsen screen.

THE WORK SHOP.—About 12,000 sq. ft. on the ground floor are used for a work shop, in which there are a wood shop, pattern shop, foundry, iron shop, machine shop, forge shop, tool repair shop, and a large tool room.

THE DRAWING-ROOMS.—The drawing-rooms are located on the north side of the building on the second and third floors, and cover a space of 11,800 sq. ft. The windows, being wide and high, admit an abundance of light. General Electric 110-volt enclosed arc lights, with opaque lower globes and concentric diffuser shades, furnish the artificial illumination. The number of lights and their location are such as to eliminate all shadows. A drawing table and stand are assigned each student. Both are built of red oak, except the table tops, which are white pine 30 × 54 ins. The tables were especially designed and contain a drawer for instruments, etc., and a closet at one side for boards and T-squares. Both drawer and closet are fitted with combination locks. A Franklin automatic, continuous-feed, electric blue-printing machine, and a blue-print frame for printing by sunlight, are installed. Suitable washing tanks and driers are also provided, and these are placed close to the printing apparatus to facilitate the handling of the blue-prints.

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How many places in the United States with a population of 50,000 or 60,000 have adequate building laws and proper control of explosives and inflammables and of electric wiring? This question is prompted by statements in a report on water supply and fire protection at Wilkes-Barre, Pa., just issued by the Committee on Fire Prevention of the National Board of Fire Underwriters (135 William St., New York City.) Three paragraphs in the general summary concluding the report may be quoted as follows:

Building Department.—Building laws of little value from a fire protection standpoint, no mention being made of modern types of construction, no restrictions placed on floor areas or heights and other important points omitted. Enforcement only fair, due to inadequate force. Structural conditions conducive to rapid spread of fire.

Explosives and Inflammables.—In a limited manner under the control of the fire chief. Laws inadequate and entirely unsatisfactory. Unnecessarily hazardous conditions found, due to lack of proper laws.

Electricity.—No municipal control. Inside wiring for past year well looked after by underwriters' inspector. Considerable obstruction from overhead wires at many points and general conditions in regard to outside wiring poor. Electrolysis under control.

We shall not attempt to answer our question as given above, further than to state that, while it is doubtless true that a fair number of cities of much less than 60,000 inhabitants are in better condition as to building laws and the like than Wilkes-Barre, yet there are many that can rightfully claim little or no superiority in most of these particulars. The attention that is being called to such defects by the long series of reports being issued by the above-named committee ought to stimulate much needed reforms in water supply and fire prevention facilities in all the principal municipalities of the country.

The U. S. Census Bureau summary of the federal, state, county and municipal indebtedness of the United States, presented on another page of this issue, cannot fail to interest many of our readers. The most striking feature of the summary is the rapid increase of municipal indebtedness since 1870. For the 12 years between 1890 and 1902, the net debt of cities, villages, townships and school districts nearly doubled, reaching about $1,400,000,000 in 1902 and slightly exceeding the combined federal, state and county debts in that year. On a per capita basis the increase in net municipal debt has not been so striking, the increase having been about 50%, or, in round numbers, from $12 to $18 per capita between 1890 and 1902. Without throwing any discredit on the figures for municipal indebtedness, we would call attention to the fact that they are very misleading, since they take no account of municipal assets, other than sinking funds. These assets represent vast sums of money in public improvements of many kinds, most of which are of a permanent character, and many of which are revenue-producing.

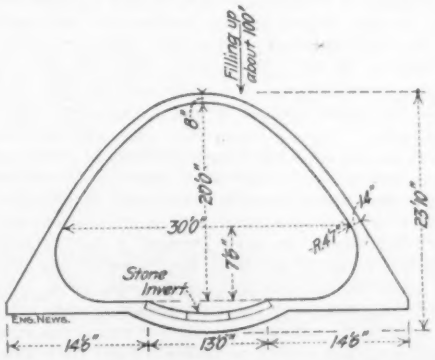
Under a proper, universal system of municipal accounting it would be possible to exhibit these municipal assets, for corresponding periods, thus enabling the student of Municipal affairs to judge more accurately of the real significance of the rapid increase in municipal debt. A considerable portion of these assets are listed for a single year, as accurately as circumstances permit, in Census Bulletin 20, Social Statistics of Cities for the Years 1902 and 1903. The figures, however, relate to cities of 25,000 population and upwards. The 175 cities in that category had "salable possessions" amounting to $1,750,000,000, of which $650,000,000 were classed as revenue-producing. It therefore appears that cities of 25,000 population and over, alone, had assets far in excess of the net debt of all cities, villages, townships, precincts and school districts in the United States, regardless of population. Numerous as are the municipalities of 25,000 and less, their aggregate debts and assets are but a small percentage of the total for all municipalities. Census Bulletin 45, Statistics of Cities of 8,000 to 25,000, for 1903, shows "salable possessions" of $212,000,000, of which $84,000,000 were classed as revenue-producing. These figures are for a year later than all those previously given, but the increase for a single year for cities of this class can scarcely exceed, if they equal, anything like the assets for 1902 of places of 8,000 population and less.

Exact figures, while desirable, are of no special moment in the present discussion, which merely aims to bring out the fact that the rapid increase in municipal indebtedness should be considered in connection with municipal assets. The latter, as has been shown, are far in excess of municipal debts, and were the figures available it would doubtless appear that a larger percentage of municipal debt is now incurred for revenue-producing works than was the case prior to 1890.

Just how far is it safe to go in the use of reinforced-concrete in fixing dimensions proportionate to stresses, as one would do in a steel structure?

We hardly need to say that engineers differ radically among themselves as to the proper answer for this question. There are plenty of engineers who hold that the present use of reinforced-concrete is a passing fad, which is just now running into intemperate excesses. There are plenty of other engineers, however, who are entirely ready to take chances, and every week sees some new and more daring achievement in reinforced-concrete construction.

We cannot recall, however, anything in American engineering practice in reinforced-concrete, that looks on its face quite as daring as is the feat which is being undertaken at the staid old town of Newcastle-on-Tyne, England. There is under construction in that city a reinforced concrete conduit 32 ft. in clear span inside and 20 ft. in height. The reinforced-concrete roof of this conduit is only 14 ins. thick at the base, and only 8 ins. thick at the crown, and the conduit is to be covered with a back-fill of earth, 100 ft. deep at the lowest portion of the valley. To give a clearer idea of what these dimensions mean, we have here redrawn from an engraving in "The Surveyor" a cross-section of this conduit, and from the same journal we reprint the following relating to it:



To engineers who are accustomed to the massive walls of brick or mass concrete usually employed in the construction of tunnels and large sewers the slender proportions of the tunnel must appear startling. The thickness of the crown, which is only 8 ins., has appeared to more than one civil engineer as representing extremely daring, not to say risky, design. But in reality this and the other dimensions are perfectly adequate, and we know as a fact that after careful consideration, all the details of the drawings were found to be in every way satisfactory by the corporation engineers.

There seem to be two main reasons why British engineers have been somewhat slow to appreciate the immense possibilities of ferro-concrete. One is that having been accustomed for so many years to deal with the ordinary product they have not realized the superiority of specially made concrete. The other reason is that they fail to grasp in its entirety the essential principles of reinforced concrete, where the steel employed takes just those stresses that would be fatal to plain concrete, and in which mere mass is of comparatively little use, and sometimes is a positive disadvantage. The correct method to be followed in ferro-concrete design is to ascertain precisely the intensity and distribution of the stresses, and to apply steel and concrete in such proportions as will offer the requisite resistance, of course with an ample factor of safety, in every part of the structure under consideration. Thus, while the average engineer thinks of concrete in yards, the reinforced concrete engineer thinks in inches.

These remarks may serve in some measure to make clear the fact that the design of the Newcastle tunnel results from the analytical treatment of stresses and the application of materials in accordance with the principles of engineering science rather than from the blind adherence to conventional traditions which govern the proportions of too many structures of the present day.

Some idea of the load to be supported by this structure may be gathered from the statement that there will be above its crown about 100 ft. of filling surmounted by the buildings of a new suburb.

We may add in further explanation of the conditions, that this conduit is to carry the water of a small stream which passes through the city, and is subject to excessive floods, which explains the large size of the conduit. The ground along which the conduit runs is of variable character. Our contemporary states that a pocket of soft earth 25 ft. deep was found near one portal of the tunnel, and had to be excavated and filled in with mass concrete.

It sounds well to say: "the reinforced-concrete engineer thinks in inches, while his more conservative brother thinks in yards," but if the said r. c. engineer thinks that he can, by his scientific methods avoid the provision of a large factor of safety to cover variations from the assumed conditions, he is making a very serious error. We have not attempted to compute the stresses in this arch under the 100 ft. fill which it has to carry, but assuming that the stresses produced are not greater than the concrete can safely carry, it remains true that the computation must be based on the assumption of uniform loads on the arch. Now, passing the question of making a 100-ft. fill in such a manner as to uniformly load the arch over a conduit about 2,100 ft. in length, the problem comes as to what settlement is likely to take place underneath the conduit. Unless this is founded on rock for its entire length, which seems most improbable, some settlement must be expected, it would seem, and any inequalities in the settlement may be expected to cause cracks in the concrete. What will happen to the reinforcing steel exposed by such cracks? The water flowing through the conduit will doubtless be more or less polluted. The ground water percolating down from the streets above will corrode the steel wherever it comes in contact with it. How much permanent reliance, then, can be placed on the reinforcing steel to carry the loads?

Certainly these questions are worth serious consideration by every engineer engaged in the design of reinforced-concrete structures, and particularly those in which, as in this case, rein-

forcing steel is to be used where the factor of corrosion is likely to be important.

We have no doubt, whatever, as to the merits of concrete and steel in combination. Even where concrete is to act solely in compression, the use of a certain amount of steel to resist temperature stresses and unforeseen variations in loading is doubtless to be the standard practice of the future. But let us not repeat the mistake which was made by the early iron bridge engineers of paring down sections to fit too closely the theoretical computation of stresses. Concrete is cheap. A little increase in the thickness of walls may largely increase the strength of a structure, and yet cause only a moderate increase in cost, for the large items of expense for labor and for forms will be very little affected.

MORE CONCERNING THE AMOUNT OF RISK IN THE PANAMA CANAL CONTRACT.

In our editorial summary of the Panama Canal contract in our last issue, we necessarily had to pass briefly over many of its features. The point we most emphasized was the extent to which the element of risk to the contractor is eliminated by the fact that the Government pays the entire cost of the work in any event and furnishes him with all the materials and with his working plant.

All that the contractor risks is his *profits* on the work, unless the penalties assessed against him for exceeding the estimated cost and the estimated time for completion should amount to more than his profits.

We have received a letter from a correspondent who is impressed with this latter possibility; and since his point of view may be that of others, we print his letter, in full, as follows:

Sir: It seems to the writer that your editorial on the contract for building the Panama Canal, has overlooked a very serious and apparently quite unnecessary element of uncertainty, if not an opportunity for a gigantic fraud that the proposed form of contract presents to intending bidders.

The risk or opportunity referred to is the probable finding of the Engineering Committee in its estimate of Cost and of Time.

Your editorial points out very clearly the magnificent inducement offered to beat the findings of the committee, either in Cost or Time, but it did not discuss the possibility of such findings being essentially unbeatable in either of these factors which affect so vitally the contractor's profit.

Many governmental reports have been made setting forth the reasons for various contractors having been behind the stipulated time on government work, but the writer has yet to see a report which will give, as a reason, that the time had been merely "estimated" in advance, and was fixed at too short a period.

The many losses and even bankruptcies that contractors as a class have had to face is sufficient testimony as to the accuracy of their advance estimates of cost. Engineer's estimates of cost are at least no better than contractor's estimates.

Perhaps if the word "guessed" were substituted for "estimated" in Article IX., this criticism of your editorial would have been unnecessary.

On the other hand, the enormous advantage that will accrue to the contractor if he can influence one of the Government representatives on the committee, so as to control the majority of the committee, or even if he can ascertain in advance what the probable findings of the Government experts will be, might result in exposing the Government representatives to grave suspicion.

It is, of course, a great compliment to the engineering profession that it is expected to furnish men who can be trusted in such a situation. But even assuming that the engineers selected by the Government are absolutely unapproachable, as the form of contract evidently expects them to be, may not the effort to stand upright cause them to lean backward, and thus injure the contractor?

Article IX. provides for the prompt finding of the Engineering Committee within 90 days from the date of signing the contract, if possible, or within six months in any event, and the contractor's time has to count from the date of the finding of the committee.

Is there any good reason why the estimated quantities, estimated cost and estimated time, should not be stated in advance and reasonable opportunity given to prospective bidders to visit the isthmus, if they wish to, so as to make their own verifications or modifications of the commissioners' estimates before they submit their offers?

Most men want to make their own beds, and this is particularly true of contractors. The contractor's representation on the Engineering Committee is intended not to be paramount. The provisions of the proposed contract require the bidder to put his interests entirely in the hands of other people.

This remarkable requirement is so at variance with all precedent, and departs so far into the realm of pure speculation, if not into dishonesty, that the writer was quite surprised by the entirely optimistic tone of your editorial.

Very respectfully,

Augustus Smith.

149 Broadway, New York, Oct. 10, 1906.

If the estimate which the engineering committee is to prepare had been made two years ago, or even a year ago, or if it were an estimate in which the contractor had to bear the entire responsibility for the work in the ordinary way, then there might be some force in Mr. Smith's objection. At the present time, however, the Engineering Committee will have the experience, extending over nearly three years of actual work at Panama, on which to base its estimates. During a year past, a force has been at work there as large as that which worked during the most active period of the French regime. In September the force excavated 289,000 cu. yds. of material. Some 33 steam shovels were at work. The double-tracking of the Panama R. R. is nearly three-fourths completed. Further, a whole lot of uncertainties that existed two years ago, such as health conditions, housing, commissary, labor supply, and the general plan of construction to be adopted, have been either wholly eliminated or reduced to their lowest terms. Again, a wholly different situation is created by the fact that the Government itself furnishes the materials and the working plant. One of the commonest causes of contractor's losses is rise in the market price of raw materials; but this does not enter in at all in the present case, as these materials are not included in the contract cost. Again, one of the commonest causes of contractors exceeding their contract time is delay in obtaining working plant or materials. In this case, however, any such delays on the part of the Government are to be added to the contractor's working time.

We believe, therefore, that the estimate to be made by the Engineering Committee can be a very accurate estimate, and not by any means a mere guess, as our correspondent assumes. It should not be at most over 10% in error; or, in a contract involving say $80,000,000, the variation of the actual cost from the estimate should not be more than $8,000,000. Now, as we pointed out last week, the penalty for excess of cost is small, while the premium for saving is large. Stated, in figures: If the actual cost exceeds the estimated cost [assumed at $80,000,000] by $8,000,000, the contractor will have his profits reduced by $800,000. But if the difference is the other way and the contractor's costs are $8,000,000 under the estimated cost, he will be entitled to a premium of $2,666,666 in addition to his stipulated percentage. In other words, the premium is more than three times as great as the penalty. Certainly no contractor can object to this provision as in any way unfair to him.

Now let us turn to the time penalties and premiums. Considering the magnitude of the work, and the large part of it which the Government assumes, it seems to us that the time penalty or premium of $100,000 per month is moderate and reasonable. Just such time penalties and premiums are frequently introduced in contracts where the entire burden is laid on the contractor, and where on that account it is far more difficult to make accurate estimates of the time of work beforehand than is the case here. The data now available on the Isthmus should make it possible to estimate the time required for completion within a year or at the utmost within two years; and we see no reason why the estimate of time should be any more likely to be below the time than above it, assuming, of course, that the work is finally let to a contracting organization that can really hustle the work and get results.

Finally our correspondent asks why the estimate of time and of cost was not made beforehand, "and reasonable opportunity given to prospective bidders to verify the estimates before they submit their offers?"

This looks on its face like a reasonable plan; but let us see as an actual practical fact what it involves. In the first place it would put off by at least six months the actual turning over of the work to the contractor. In the second place, would the risk to the contractor really be so much less under this plan? It is true the contractor would know beforehand the estimate of cost and of time to which he was to be held; but he would not know how nearly correct it was, and without spending an amount of time and money which would not be warranted on the mere chance of finally securing the contract, he would not be able to find out.

Contrast with this his present opportunity, where he has the privilege of selecting himself two of the five engineers who will make up the Commission. If he is shrewd he will select for his representatives engineers of such force, standing and experience that they will exercise a very great influence in the preparation of these estimates.

It is true that the Panama Canal contract leaves some risk for the contractor to assume; but the risk is far less than that which he takes as a matter of course in any ordinary contract and is no more than would seem to be necessary to give him a large incentive to do the best work at Panama that any contractor's organization has ever achieved.

CONCERNING INSTRUCTION BY CORRESPONDENCE.

On Tuesday, Oct. 16, there was celebrated at Scranton, Pa., the fifteenth anniversary of the founding of the International Correspondence Schools. When this enterprise—the pioneer in the system of teaching by correspondence—was in its infancy, it was looked at askance by professional educators. It is hard enough, they said, to teach a boy mathematics and science and technology and engineering when you have him before you in the class-room. How can you accomplish anything when student and instructor can only communicate by letter? It is hard to teach even bright boys, with minds trained by years of study in preparatory schools. How can you teach ignorant men, who have only had the first two of the three R's? Is it not an imposition to pretend that you can do this?

Such were the opinions of professors in the engineering schools a dozen years ago. But at the anniversary exercises at Scranton last week, representatives were present from the most prominent engineering schools of the country. They came to congratulate the founder of these correspondence schools on their wonderful success and to learn more of the methods by which this success has been attained.

As many of our readers will recall, these schools had their inception in the demand from the anthracite coal miners of Pennsylvania for instruction to enable them to pass examinations for positions as mine foremen and superintendents. The frequent accidents in the anthracite mines led the Pennsylvania legislature to enact laws requiring mine foremen and superintendents to pass examinations arranged to test their fitness for their work and their knowledge of such matters as mine ventilation and drainage, so important to the safety of the whole working force.

Immediately a demand arose for instruction to enable mine workers to pass these tests. Mr. Thomas J. Foster was then editor and publisher of "The Mining Herald," and after some experimenting in the publication of questions and answers in his paper he developed a systematic course of instruction in those departments of mining engineering which a mine foreman, inspector or superintendent needs to know. A special textbook in the shape of instruction papers was prepared and it was arranged that the students should send in written work designed to thoroughly test their knowledge of the subject. A corps of examiners was provided to go over the students' work and by correspondence with them give them aid on any point where the

student showed deficient understanding and need of help.

The success of this first correspondence course of instruction was immediate, and its enterprising originator at once set about the task of applying the same system to instruction in many other branches of engineering, technology and commerce. The termination of a decade and a half of this work finds an educational establishment which in the magnitude of its work challenges comparison with the great institutions of learning and even with the systems of public instruction supported by great cities and states. A few figures will best show this: The total enrollment in the schools is now in round numbers 930,000. A year ago, 90,000 pupils had either received diplomas or completed advanced subjects in the courses for which they were enrolled and 250,000 others had completed elementary studies in mathematics, drawing or other preliminary studies of their course.

In the year 1905, the total number of recitations or other student work sent in to the Schools and corrected by them was 732,069, and 100,080 letters of special instruction were written.

The Schools are housed in their own buildings, which will compare favorably in architectural excellence and solidity of construction with school or office buildings anywhere and represent an investment of over half a million dollars. The operating force in all departments is 2,800.

The financial summary was given as follows by President Foster in his address at the Anniversary Exercises:

> The first year, the receipts of the Schools were $14,-991; the second year, $35,939; the third year, $73,844. Last year they were $4,200,000. Last month they were $425,000, which is more than in any previous month. We receive $40,000 per year from New Zealand; $30,000 per year from South Africa; the Canadian Agencies send us $180,000 per year. The whole amount received in the 15 years that the business has been conducted is $28,775,000. There has been paid $2,300,000 in dividends to the stockholders.

While a business which is showing gross earnings of over $5,000,000 a year challenges the attention of business men, an educational institution which is absolutely self-supporting, and which is giving something in the way of systematic instruction to hundreds of thousands of men and women, deserves the careful study of educators.

There is no conflict or rivalry, be it understood, between the correspondence school and the university or the schools of technology. The correspondence schools offer instruction to a class which no other school reaches or can possibly reach. It opens a door of opportunity to hundreds of thousands against whom all other doors are shut. It may be a small door and one hard to squeeze through; yet many do pass through it and onward to better things.

A large measure of the success of the correspondence schools is undoubtedly due to their adoption of business methods in pushing their business. The tradition that a school must only advertise by a modest card has been thrown to the four winds. Ordinary schools sit down and wait for students to come to them; but the correspondence schools have literally gone out into the highways and hedges and compelled them to come in. Mr. Foster calls this work "Inspirational Publicity." He estimates that 75% of those who are enrolled in the schools would never think of studying were not their dormant ambitions raised by striking advertisements. We quote further from his address as follows:

> You cannot give away education, even though you give free instruction. Men will not study unless strongly influenced. Students with whom the desire for improvement is a controlling motive, will take full advantage of opportunities for free instruction, but the proportion of the ambitious to the whole number that should study, is small. Most of those we enroll will not accept a scholarship as a gift on condition that they are to use it, before their ambition is aroused and their self-confidence stimulated.
>
> Of the great majority who undertake to study, it is true that they need in the start, until the study habit is formed, every aid to perseverance. The more this class pay for tuition, the better, as the fact that they themselves pay the price is an incentive to work.
>
> The greater portion of the I. C. S. Courses are sold to careless and indifferent persons, by arousing their ambition, building up their self-confidence, and inducing them to enroll by what I shall call inspirational publicity and inspirational solicitation.
>
> There are but two ways to sell: First, through publicity, which is advertising; and, second, through solicitation, which is salesmanship. We employ both. We publish and talk the benefits of education and the great rewards open to men who can do work better than their fellows; that education is the key to the doorway to success; that we have a practical means for men that work to educate themselves in their work at their work; that a man can form the study habit and educate himself; that we have special textbooks, easy to learn, easy to remember, and easy to apply; that the price is within the reach of all since it can be paid at the rate of $5 or $3 per month, and that if, for any reasonable cause, such as sickness, or loss of employment, the student is unable to make his payments promptly, he is given time, and permitted to continue his studies in the interim without additional charge.
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> * * * * * * * * * *
>
> The advertising is made effective by illustrations that catch the attention of the indifferent, untrained mechanic, make him realize his unfortunate position, and suggest to him that he can improve his condition by mastering the theory of his trade.
>
> The enrollment is not made from the educated or cultured classes; the only qualification required to enter for a Course is the ability to read and write English. The plan is intended for persons ignorant of elementary mathematics who cannot attend a regular school to study, and for whom there had heretofore not been provided a practical means for self-education. We find that drawings, such as "Are Your Hands Tied," "On Which Side of the Desk Are You," etc., will halt these people as they drift through life, and give them the first suggestion they have ever had, perhaps, that there is something better to which they can attain.
>
> If our advertisements were simple announcements of technical courses to sell, as are the advertisements of the regular schools, we would not have one inquiry where we now have a dozen.
>
> * * * * * * * * * *
>
> One of the greatest needs of the time is some agency to make more of the people desire education sufficiently to deny themselves to obtain it. If Mr. Carnegie will supplement his magnificent gifts for libraries by establishing a foundation to provide half a million dollars annually to be expended in advertising the benefits of education and the resources of his libraries, he will be surprised by the great increase in the number using his libraries.
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> * * * * * * * * * *
>
> The Field Organization of the Schools consists of 800 Routes, grouped in 240 Divisions of three or more Routes each, which are arranged in 34 Districts of 7 or more Divisions each, and cover the United States and Canada. 1,200 salesmen represent the Institution in these Routes, Divisions and Districts.
>
> * * * * * * * * * *
>
> The salesmen arouse the ambition of people ignorant of or indifferent to the advantages of technical education; create in them a desire for self-improvement; convince them that they can educate themselves by home study, and induce them to undertake courses of instruction, and afterwards encourage them in the cultivation of application, concentration and the study habit, that they may persevere in their studies.
>
> A salesman can tell more effectively than advertisements the story of the great disadvantages the working man labors under, who is ignorant of arithmetic, drawing, and the theory of his trade, and can speak with more effect of the opportunity offered by the Schools to remove these advantages. He makes the prospective student dissatisfied with his present condition, and points out the road to better fortune. He can give full particulars, answer objections, and remove doubts. He convinces the prospective student, and, if necessary, convinces also the wife or father, or mother, or all of them. It is often necessary to do this, because an engagement to pay for a Scholarship is an important transaction for many workingmen, and other members of the family must sometimes be consulted. Most of the students obtained from advertising are enrolled by salesmen. The advertisement secures the interview for the salesman.
>
> The student body created during the past 15 years is as productive a source of new enrollments as is the advertising. The alumni of a college is a valuable asset; and the army of hundreds of thousands of I. C. S. students is a powerful ally in promoting its interests. The student enrolls, makes sufficient progress in his Course to derive benefit, and tells his friends. An advertisement is not so effective as the testimony of a student who, through home-study training, has advanced in his trade, or in some other occupation, to a position of responsibility. Seeing is believing. Such testimony creates a desire for improvement in thousands who might otherwise remain indifferent. Every month, hundreds of students are promoted. They know the work and its great value and can intelligently and earnestly urge their fellows to do as they have done.
>
> Many students voluntarily assist the salesmen in enrolling their friends, and all who do assist are paid for the service, if they will accept payment. The students are systematically solicited to aid in the work, on altruistic grounds, and without their assistance the large enrollment required to minimize costs could not be obtained. The same equipment in textbook plates, buildings, printing plant, etc., and the same organization at home and in the field would be required if the enrollment were but 5,000 per month.

We have given considerable space to Mr. Foster's explanation of this work of "Inspirational Publicity and Solicitation," because the criticism of and prejudice against correspondence schools among professional educators have doubtless had as their chief basis the methods chosen by the schools to win publicity.

It seems to us, however, that Mr. Foster thoroughly justifies this feature of correspondence school work. He says that 25% of the students in his schools are sold to men engaged in the engineering trades or professions, or to persons who desire to qualify themselves to pass civil service examinations, or who are "alive to the advantages of technical training." Thus about 25% of the business of the correspondence schools comes through an existing demand for instruction; but the other 75% is secured by creating the demand.

There can be little question in the mind of anyone that the work done by the correspondence schools for the 25% who demand it is fully justified; and indeed deserving of high praise. Those who criticise it should remember that these schools are offering instruction and aid to men who have no other means of obtaining it. They help men to help themselves. Public and private schools reach only the youth, and so far as the masses of the people are concerned, only the children. The public library, the newspaper and the popular lecture course are all valuable as popular educational agencies; but they cannot give systematic instruction. The correspondence schools alone offer a methodical plan for self education by those in adult life; and for systematic technical instruction to workers in the trades.

And now what of the other 75%, who, as Mr. Foster says, are secured by "creating the demand"? Are the schools warranted in holding out to this class of students glowing prospects of promotion, better pay, and other gains as an inducement to them to enroll and undertake the task of self-improvement? It seems to us that this question also must be answered in the affirmative.

It is true that a very large proportion of this class of students will prove unequal to the task set. Perseverance and self-denial, continued month in and month out, year in and year out, are none too common among the students who have all the advantages that education can bring. It is not surprising, therefore, that a third of those who enroll in the Scranton schools get discouraged and give up before they have completed the payment for their scholarships. Quite as large a percentage of those entering the Freshman class in our colleges, we should judge, drops out before the course is half completed.

Again there will be those among the Correspondence School students who after completing their full course of study will be disappointed in their expectation of profitable employment or promotion. Other personal qualities which instruction cannot improve or remedy may stand in their way; or they may be located where influence counts more than merit. Such facts are not to be counted against the correspondence schools any more than against the colleges, a certain percentage of whose graduates find their pathway to success blocked by similar causes.

On the whole, then, it seems to us that the unique campaign of the correspondence schools in exploiting the advantages of home study and self-improvement are not only justified but are deserving of the highest praise. We should call it "missionary work" were it not that that phrase

has been so McCurdyled that all its milk of human kindness has been changed to putrid acid.

We have been thus specific in attempting to meet the criticisms of and prejudices against the correspondence schools, because their work and their methods appear to us to deserve even more than they have received of the attention and study of professional educators, and we desire to clear away any obstacles in the way of this result. The efforts the schools have devoted to making text-books which the student working by himself could understand without the aid of a teacher appear to us a notable step in advance. The emphasis which they have placed on thorough work in the elementary studies at a time when in other schools these studies are crowded to one side to make room for the fads is another matter well worth public attention.

We are not blind to the dangers which beset correspondence instruction through the fact that it is carried on as a business, for profit. The same dangers exist in the case of some of our private schools which are conducted from similar motives; but in the one case as in the other; the largest profits will be reaped in the long run by the institutions which fulfil their promises and which really give to the student the best training which their system is capable of furnishing.

LETTERS TO THE EDITOR.

A Locke Hand-Level Fixed Up for Stadia Work.

Sir: There is nothing new under the sun. The improved hand level noticed in Sept. 13 issue is no exception, although it seems to give promise of being a very convenient instrument.

I have been much interested in some of the survey "wrinkles" used in this land of fever and Mañana, where all intelligent labor must be imported and is correspondingly costly. Here is one: One of the canal surveyors on topographic work some time ago painted horizontal segments on his Locke hand-level, so as to leave a clear, central band whose height is the stadia interval, thus making a very effective stadia arrangement. In these tropical forests where every foot must be cleared, such a device in the hands of careful men means a material saving of time, energy and labor (clearing), while its precision is fully equal to the needs of much of the "filling in" between "control" points. It has, in fact, proved remarkably accurate and forms a very useful check on the control traverses themselves.

Possibly some of your readers may have heard of this wrinkle. I know that many have not. I shall use it on occasion, and I pass it on to others.

Yours truly,

H. K. H.

Colon, Panama.

The Amount of Water Used in Fighting a Serious Boston Fire.

Sir: Concerning the amount of water used in fighting fires, the following information may be of interest, if only as a matter of record. The information is taken from the testimony of Mr. F. P. Stearns, Chief Engineer of the Metropolitan Water-Works, before the auditors in the suit for the taking of Spot Pond (p. 2369). The information was compiled from the Venturi meter chart records for the 48-in. Venturi meters on the Boston low service mains. Mr. Stearns said:

> The diagram for Nov. 12 [1904] happened to show the existence of one of the largest fires that have occurred in Boston since these meters have been in use [Harcomb Bldg.]. The number of engines in use at the fire was 21; length of time for each engine, from 1 hr. 15 min. to 17 hrs. 20 min. The results from the autographic records indicated that there was an excess of flow from 12 p. m. to 6 a. m., Nov. 12. The maximum rate of flow during this period above the usual flow was 15,000,000 gals.; that rate lasted for 30 minutes. The total quantity of water used in excess of the ordinary amount was 2,150,000 gals.

Very truly yours,

Caleb Mills Saville.

30 Coolidge St., Brookline, Mass., Oct. 12, 1906.

[The fire use of water here was at the average rate of about 118,000 gals. per hr. for the longest period that any of the 21 engines were in use, or some eight times the New York rate given in our issue of Sept. 13, 1906, and adversely commented on by a correspondent in our issue of Oct. 11, 1906 (p. 383). But the moral drawn from the New York figures—the small quantities of water used in fire-fighting—is unaffected.—Ed.]

How May an Engineer Advertise?

Sir: As a young engineer, located where there is competition, I desire to build up a good practice in general municipal engineering and surveying. In order for me to keep busy in the class of work I seek, it will be necessary for me to work over a considerable territory. I should like to know to what extent it is proper for me to advertise my business without in any way overstepping the bounds of engineering ethics.

(1) Is it proper, in advertising in a periodical, to state one's experience and qualifications? (2) In applying for a position, is it customary to state fully one's fitness for the place? (3) Would a similar statement in the form of a letter, widely distributed, requesting appointment as engineer on sewerage or other public work be admissible? (4) Would a letter, generally circulated, requesting a share in the business of a person who might employ engineering assistance, be out of place?

Respectfully,

E. M. A.

[In reply to (1), while the simple professional card is perhaps oftenest seen, many engineers state in connection with their published professional cards in a brief way what their experience has been or what positions they have held. It is, of course, entirely proper in publishing a professional card to say definitely what class of work one seeks and is specially qualified to perform. No reason is apparent, therefore, why one should not go farther and state the experience that has qualified him for such work. Regarding (2), by all means, in applying for a position, state fully and explicitly just what in your training or experience has fitted you for the place. Put yourself in the place of the man who has to sift the applications and the reason for this will be clear. The answer to (3) is not so easy. A circular *letter* sent out requesting appointment would be apt to injure a man's reputation. The natural conclusion is that a man must be out of work, or he would not adopt such a method to seek it. On the other hand, engineering firms of high standing send out circulars, booklets, etc., describing the class of work they have done. So, too, in reply to (4), a circular letter might repel, instead of attract a client, while an impersonal professional card, printed or engraved, calling attention to the fact that the person or firm is open for professional engagement, could do no possible harm.—Ed.]

More Concerning the Depth of the New York Barge Canal.

Sir: My attention has just been called to your comments, in your issue of July 26, last, on the enlargement of the locks of New York's thousand-ton barge canal and the refusal of the Canal Board to adopt the recommended depth on the sills. I presume you will recall very well that the thousand-ton barge canal proposition was carried by the cities of New York and Buffalo against the rest of the state, and you are probably aware that the chief advocates of the canal in Buffalo desire only a canal that will make Buffalo in some degree a port and not a way station. With this knowledge, is it not significant of the real influence determining the final decision as to the depth on sills that this decision is made wholly by politicians against the advice of all of the noted experts connected with the work?

Yours very truly,

Wm. G. Raymond.

Iowa City, Iowa, Oct. 12, 1906.

[Prof. Raymond (who, as our readers will recall, was long connected with Rensselaer Polytechnic Institute, and is thus familiar with the Barge Canal history) doubtless sets forth the real reason why the advice of the Board of Expert Engineers is rejected. The whole barge canal enterprise was promoted and finally carried through the Legislature by certain interests in Buffalo and New York City, which control the freight transfer facilities of those ports. These interests want to see business restored to the canal, but are strenuous that the canal shall not be made big enough so that vessels passing through it can go past the terminals at New York Harbor and Buffalo to discharge their load at other ports. They do not want the taxpayers' hundred million dollars spent for a canal which will best accommodate the traffic, but for one which will best serve the interests of the combinations which control the elevator and freight transfer facilities in the ports of New York and Buffalo.

It is well that it should be definitely pointed out that it is these interests and not the engineers, which are responsible for the new York 1,000-ton barge canal. If that enterprise proves a colossal disappointment to the state no blame need be laid at the door of the engineering profession. Warning of its inadequate size has been repeatedly sounded by men among the most eminent in the profession.—Ed.]

Concerning the Failure of a Reinforced Concrete Girder Bridge.

Sir: Referring to the small reinforced concrete bridge, a description of which was given in your issue of Sept. 27, which failed under the load of a traction engine, it seems to me that engineers should register a protest against two reprehensible practices exhibited by the designer in his calculations. The use of 32,000 lbs. per sq. in. as a safe unit stress for dead load on steel is one of these practices, which is rendered the more invidious by being disguised as 16,000 lbs. with a "factor" of two. The other is the assumption that a load that is concentrated on four wheels may be taken as uniformly distributed over 240 sq. ft. of space, all because of a foot of earth fill and a few cross rods.

Yours very truly, Edward Godfrey.

Pittsburg, Pa., Oct. 5, 1906.

Sir: I refer to Mr. Daniel B. Luten's letter in Engineering News of Sept. 27, and making use of his invitation for a discussion on the subject in question, I wish to say:

(1) The approximate method used by Mr. Luten in determining the stresses in the slab is in so much correct as the result arrived at by him is practically the same as derived by a more exact computation.

A section 7 ins. deep, 12 ins. wide, with a steel rod of 0.93-sq. in. at 1 in. from bottom; the neutral axis is for this section at 2¾ ins. from top, and the effective depth is $= 7 - \left(1 + \frac{2\frac{3}{4}}{3}\right) = 5.08$ ins. Using Mr. Luten's loads, we have:

Stresses in extreme compression fiber:

$$S_4 = 76{,}800 \div \left(\frac{12 \times 2\frac{3}{4}}{2} \times 5.08\right) = 916 \text{ lbs. per sq. in.}$$

$$S_1 = 158{,}000 \div \left(\frac{12 \times 2\frac{3}{4}}{2} \times 5.08\right) = 1{,}880 \text{ lbs. per sq. in.}$$

Total compression = 2,796 lbs. per sq. in.

Stresses in steel:

$S'_4 = 76{,}800 \div (0.93 \times 5.08) = 16{,}270$ lbs. per sq. in.

$S'_1 = 158{,}000 \div (0.93 \times 5.08) = 33{,}470$ lbs. per sq. in.

Total tension = 49,740 lbs. per. sq. in.

(2.) The assumption Mr. Luten makes about the wheel load being distributed over 5 ft. of slab seems to me not quite reasonable. A width of 2 ft. 6 ins. would seem to fit the case better. For this new assumption the total compression per square inch in concrete is

$$916 + (2 \times 1{,}880) = 4{,}676 \text{ lbs. per sq. in.}$$

and the total tension in the bar is

$$16{,}270 + (2 \times 33{,}470) = 83{,}200 \text{ lbs. per sq. in.}$$

There is no wonder that the structure collapsed the moment the heavy engine was on .

Yours respectfully,

I. N. Prenovich.

1469 Fifth Ave., New York, N. Y., Oct. 1, 1906.

Sir: On page 337 of your issue of Sept. 27 Daniel B. Luten criticises the design of a reinforced-concrete highway bridge, his criticism being fully sustained by the subsequent failure of the structure.

The writer considers the design of the floor poor in point of arrangement of the steel bars transverse of the roadway, involving the necessity of the two longitudinal girders, one on either side of the roadway. This general design and arrangement would be justified only in a case where the span would be greater than the width of the roadway. In the case in question the span is equal to the width, being 15 ft. for each.

It appears that the bridge failed under a road roller having 9,000 lbs. on rear axle. The wheels on this axle would be 6 ft. apart center to center. With this load, the maximum live load moment was 243,000 lbs. If the steel bars had been placed longitudinally with the roadway, the maximum moment would have been 192,500 lbs., or 50,500 lbs. less than in the adopted design. In addition, the longitudinal arrangement would have brought one or more bars directly under each wheel, whereas the transverse plan concentrated the entire load over one bar only. It is quite evident that the longitudinal plan would have given a much better distribution of wheel concentrations over a considerable floor area, and, moreover, would have eliminated the necessity for the two longitudinal girders. The latter are unnecessary addi-

tional elements of uncertainty, and quite undesirable since they carry the entire floor, and a failure of either necessarily brings down the entire structure. In the longitudinal plan, the load would be carried directly to the abutments, and a wheel concentration might break a hole in the floor without materially injuring the structure as a whole.

Adopting the longitudinal plan of reinforcement and taking the weight of the concrete floor and 12 ins. of earth thereon at 225 lbs. per sq. ft., and assuming that the total load of 9,000 lbs. on the rear axle was equally divided on the two wheels, and that the wheel loads were distributed 5 ft. transversely, the maximum moment would be 114,460 lbs. per foot of width.

On this basis the writer would fix the depth of the floor slab as follows:

$$d = \sqrt{\frac{m}{140w}}$$

in which

d = depth from top of slab to center of steel,
m = max. moment for value of w,
w = 12 ins.,

from which d becomes 8.25 ins., to which should be added 1.5 ins. of concrete below center of steel, making total depth of slab 9.75 ins.

The above formula is derived from the assumptions that the neutral axis is midway between top of slab and center of steel; that the center of pressure in concrete above neutral axis is $\frac{5}{6}$d above center of steel; that the variation of stress from the neutral axis upward is measured by a straight line; and that the safe maximum compression on extreme fiber is 504 lbs. per sq. in., with a resulting mean pressure of 336 lbs. per sq. in.

Since we have neglected any load on the front wheels of the roller (no data for same being given), it is quite evident that the depths of 6 ins. and 7 ins. in the floor slab that failed are too small as compared to 8.25 and 9.75 ins. determined as above.

If we take 400 as a safe mean pressure per sq. in. on the concrete above the neutral axis, the formula above becomes

$$d = \sqrt{\frac{m}{167w}} \text{ and } d = 7.56 \text{ ins.}$$

Taking 16,000 lbs. per sq. in. for maximum tension in steel, the percentage of steel in terms of concrete above the neutral axis becomes 2.1% or 2.5%, depending on whether 336 or 400 lbs. compression in concrete is taken, or 1% or 1.25% of the area above the steel.

As the writer believes that 400 lbs. should be the maximum mean pressure on concrete (especially under a moving load), he is of the opinion that the effective depth of 6 ins. in the floor slab that failed stressed the concrete beyond the safe limit and contributed materially toward the failure.

Also, taking 2.5% of the area of the concrete above the neutral axis as the necessary area of steel, gives 1.13 sq. ins. of steel per foot of width of slab having an effective depth of 7.56 ins., as against 0.93 sq. in. in the slab that failed, with an effective depth of 6 ins.

The writer estimates that the theoretical stresses in the structure that failed were about 1,000 lbs. per sq. in. on extreme fiber of concrete and 26,800 lbs. on the steel. These, in connection with the inferior workmanship described by the designer, are evidently cause enough to account for the failure. If the quality of materials had been first-class, and the work executed precisely to the design, it is probable the failure would not have occurred.

Nevertheless, with even the best of materials and workmanship, the writer could not consider the design as giving a satisfactory margin of safety.

Yours truly, J. L. Campbell,
M. Am. Soc. C. E.

El Paso, Tex., Oct. 4, 1906.

[The assumption made by Mr. Campbell that the compressive stress in the concrete varies as a straight line, from the neutral axis up, means that in a beam of rectangular cross-section, a slab for instance, the maximum compression in the concrete is *twice* the mean compression, not merely one and a half times the mean. Thus, the first formula Mr. Campbell gives corresponds to an extreme-fiber stress in the concrete of 672 lbs. per sq. in., and the second formula involves an extreme-fiber stress of 800 lbs. per sq. in., not 504 and 600 lbs. The remainder of Mr. Campbell's argument must be read with proper allowance for this discrepancy.

It is also necessary to bear in mind that the bridge was supposed to be designed for a rear axle load of 24,000 lbs., while Mr. Campbell's tentative design is for a rear axle load with only 9,000 lbs.—Ed.]

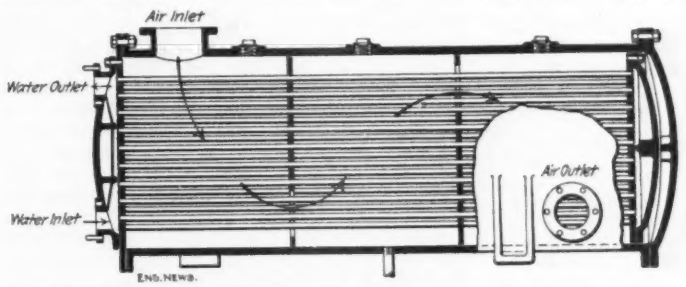
Notes and Queries.

A correspondent, referring to the article on Transcontinental Railway Lines in our issue of Oct. 4, states that the Canadian Pacific is expending a large sum on a terminal at Spokane. He also states that he was informed, when in Spokane recently, that a branch to that point was being built.

In the list of American engineering societies published in Engineering News June 21, 1906, and July 19, 1906, the names of the local organizations of the National Engineering Societies were not included. The following are the local associations of members of the American Society of Civil Engineers, with their respective secretaries: San Francisco Association, Mr. Franklin Riffle, 131 Kansas St., San Francisco, Cal.; Kansas City Association, Mr. C. S. Burns, 709 Dwight Bldg., Kansas City, Mo.; Memphis Association, Mr. A. L. Dabney, 558 Randolph Bldg., Memphis, Tenn.

A NEW FORM OF INTERCOOLER FOR AIR COMPRESSORS.

The economy of multiple-stage air compression depends very largely upon the efficiency of the intercoolers used. The intercooler shown in the accompanying illustration has been designed to give high efficiency by employing baffle plates to thoroughly mix the air and bring it into contact with all parts of the cooling surface of the tubes. The tubes, in turn, have been so spaced as to divide the air as it passes between and around them, into thin sheets. The heads covering the tube sheets, also, are provided with



AN INTERCOOLER FITTED WITH BAFFLE PLATES AND OTHERWISE DESIGNED FOR HIGH EFFICIENCY.

ribs which abut against the tube sheets and compel the water to pass from end to end of the intercooler several times.

The heads of the intercooler are of cast iron, and the shells either cast iron or wrought steel, depending upon the size and pressure. The tube sheets are of thick plate, and the tubes are brass expanded into the tube sheets. The rear tube sheet is covered by a head which is in no wise connected to the shell, but is free to slide within it, thus providing for any difference in expansion between shell and tubes. The rear end of the shell is closed by a separate head. As shown by the cut, the front head to which the tubes are attached can be removed and the tubes withdrawn for inspection and cleaning. Suitable provision is made for draining off the water which is precipitated from the air by the lowering of its temperature while passing through the intercooler. The Allis-Chalmers Co., of Milwaukee, Wis., are using this form of intercooler in connection with their multi-stage air compressors.

IMPROVED SEWAGE DISPOSAL for Washington, D. C., is making good progress, according to a report by the Superintendent of Sewers, just submitted to Major John Biddle, Corps of Engineers, U. S. A., Engineer-Commissioner of the District of Columbia. A number of intercepting sewers have been completed, others are under construction, and it is expected that the sewage pumping station will be ready for operation by Jan. 1, 1907. Two paragraphs from the report may be quoted as follows:

The sewage disposal project is based upon the discharge of sewage from a population of 500,000 into the Potomac River, which furnishes sufficient water for its dilution to an inoffensive condition.

It is wise to consider what will be necessary when that population will be exceeded, because any method of treatment will require the purchase of land, and available land may be expected to increase in value. With the completion of the present project an investigation of the future requirements of the District is proposed, based upon modern methods of sewage purification as illustrated in works now in operation in Birmingham, Manchester and other English cities; in works under construction in Columbus, Ohio, and Baltimore, Md.; and experimental work in other localities.

THE TECHNICAL PRESS AS AN EDUCATIONAL INSTITUTION.*

We are assembled here to-night to celebrate a new epoch in the life of a great educational institution. You who are its loyal sons have honored me with your invitation to join with you in this celebration. It gives me great pleasure on behalf of the Technical Press to express to you most hearty congratulations on the completion and formal dedication of your beautiful new building.

Now, what has the Technical Press to do with an occasion of this sort? Why do you give the Technical Press a hearing at this time, instead of the Reading Railroad, or Wanamaker's store, or the United Gas Improvement Company? There is a reason and a very sound one. The reason the Technical Press is represented here to-night is because it is an educational institution. That is too long a term, so let us call it a school.

It may be a new idea to many of you that the Technical Press is a school. It never has been counted in by the statisticians of the Bureau of Education. No state nor city pays taxes for its support. Not one tainted cent of anybody's money has ever been invested for its endowment. Yet I will vigorously defend the thesis that the Technical Press is a school; and a school whose influence for progress can hardly be overestimated.

The building to-day dedicated will shelter about six hundred students; but in the world-wide class-rooms of my own institution you may find thrice as many thousands. The students of the technical school are boys, perhaps 18 to 23 years old; but the students of the Technical Press include not only these youths, but their instructors as well, and not only the instructors, but the men in active professional work, ranging all the way from the green graduate, trying to hold down his first job, to the Nestors of the profession, full of years and honors, and let us hope of dollars also.

Pardon me if I make one more comparison. The boys who receive their training in the fine building dedicated to-day are not, at their graduation, engineers. They have only laid a good, strong, permanent foundation. The force headed by Professor Marburg and Professor Spangler have sunk the caissons deep in those hollow skulls and filled them with concrete—facts. It is a fine foundation, clear up to the capstone on top of the pier—but the superstructure is still to be built. The boy goes out after graduation and goes to work to become an engineer, and his instructor and mentor and aid in this post-graduate course is the technical journal.

I want to emphasize the fact that it is the superstructure and not the foundation which it is the business of the Technical Press to build. Any intelligently conducted technical journal excludes from its columns elementary matter, contained in standard text-books, and also everything which is already matter of common knowledge in the profession. It seeks for the benefit of its readers the sort of information which is not yet found in the text-books nor taught in the class-rooms. Wherever a man is doing work in a new and a better way with new and better tools or machines—wherever progress is being achieved—it is the province of the Technical Press to make that progress public for the general benefit.

And now let me point out to you one radical difference between the technical school and the Technical Press School. The professors in the technical school are there to instruct their pupils; but the editors of the Technical Press are never wise enough to instruct all of their readers all of the time. The wisest attempt it least. The real teachers in the Technical Press School are not the editors, but the contributors. The technical journal is a cooperative exchange. Its business is to tell the story, week by week or month by month, of current progress. Its pages are wide open to the man with a record of progress—real progress and not mere blowing of horns—if that record will be of practical service to the readers. The editor's function is like that of a baseball umpire—to say what is a hit and what is a foul and to endure with patience the objurgations of those who object to his decisions.

There is a reason for the amazing growth in power, influence and value of the Technical Press. It is found in the rapid growth of the profession. Time was when the whole engineering profession was like a little family; everybody knew what every one else was doing, and it was easy enough to pass the records of new ideas and current progress from hand to hand. That time long since passed away. Have you made some improvement

*Remarks by Charles Whiting Baker, Editor of Engineering News, in response to the toast: "The Technical Press," at the dinner of the Engineering Alumni of the University of Pennsylvania in celebration of the completion of the new Engineering Building.

in current practice, solved some new problem, completed some task of which your professional brethren would be glad to know? Unless the Technical Press tells the story it will remain unknown, and your success will be of no advantage to others.

And here, lest I may seem boastful, let me frankly confess to you that, like every other human institution, the Technical Press is not ideal. Very, very few of its editors are infallible. It does make mistakes, many of them. It has its evil tendencies, as well as its contemporaries in the daily field. Yellow journalism—the substitution of the sensational for the useful, and exaggeration in place of accuracy—is not unknown among us. I need not multiply the list of things wherein we fall far short of what we ought to be. Enough to say that in its rapid evolution the Technical Press is only now beginning to find itself, only now beginning to appreciate its vast possibilities of practical usefulness to the profession. My excuse for taking your time here is only that you may understand what you ought to look for in your technical journals; that you may hold them to the highest standards.

And now in conclusion permit me to draw one more comparison between such a technical school as that which is here conducted and the Technical Press. I am sure that those who conduct the engineering school of the University of Pennsylvania are ambitious that their graduates shall carry away with them something more and better than mere engineering facts and formulas, something finer than mechanics or chemistry. If somehow or other the boy in the course of his professional studies does not absorb the true professional spirit, does not develop sterling moral character, honesty, fidelity and self control—if he lacks these things, he cannot be said, in the true sense of the word, to have received an education.

So in my own school—in the Technical Press. We aspire not only to instruct but to educate. Fall far short though we may, it is our ideal to influence our readers towards higher standards of professional ethics, broad conceptions of their duty toward the public, a judicial view of questions in controversy.

Far be it from me to claim that we of the Technical Press are as yet fully realizing and carrying into effect this high ideal; yet we are striving after it. To show you that our efforts in this direction, feeble though they be, are occasionally appreciated, I want to read to you an extract from a letter which we once received from a reader, and which is the most flattering testimonial that I ever had or ever expect to have. It reads, verbatim, as follows:

The Engineering News Publishing Co.

Gentlemen: Considering that at present the population on the Earth love all that it is more profittab'e to her self, I am glad to say you that Engineering News Publishing is the best writting that you can do—because it is useful, instructive, scientifical. Only this book shows to all people the right way to follow for their better. I am,

Your very truly.

I will not venture to claim that we actually accomplish as much as the writer of this letter said; but if we can in some small degree aid those who lay a foundation in this new building which we have dedicated, toward "the right way to follow for their better," you will surely agree that the Technical Press may rank as an institution of higher education.

THE FIRST CONTRACT FOR THE ADDITIONAL WATER SUPPLY OF NEW YORK CITY.*

The Board of Water Supply of New York City is about to let the first contract for part of the new $160,000,000 system of water-works to supply New York City with 500,000,000 gals. of water daily from the Catskill Mountains. The principal features of the entire system are: The Ashokan reservoir, a very large impounding reservoir, about 12 miles long, of over 100,000,000,000 gals. capacity, in the valley of Esopus Creek, about 14 miles northwest of Kingston; an aqueduct approximately 82 miles long; a large storage reservoir, to be known as the Kensico reservoir, near White Plains; a filtration plant near Scarsdale; a terminal distributing reservoir, to be known as Hill View reservoir, in Yonkers, just north of the New York City line; and conduits from Hill View reservoir to the various boroughs of the city. Catskill aqueduct will extend from Ashokan reservoir to Kensico reservoir and thence to Hill View reservoir, and will comprise a number of stretches of plain concrete conduit 17 ft. high by 17½ ft. wide inside, a number of tunnels on the hydraulic gradient, several siphons across shallow valleys, to be made of reinforced concrete or steel pipes, and other siphons, crossing deep valleys and the Hudson River, which will be masonry-lined tunnels designated to withstand great pressure.

The contract about to be let is for portions of the plain concrete conduit, known as cut-and-cover aqueduct, three tunnels on the hydraulic gradient, and a short piece of reinforced concrete pipe, in the towns of Cortlandt and Yorktown, Westchester Co., and Phillipstown, Putnam Co., between the valleys of Hunter's Brook and Foundry Brook. The Hunter's Brook or southerly end of the line is about five miles southeast of Peekskill station on the Hudson River division of the New York Central R. R. and 3½ miles west of the Yorktown Heights station on the Putnam division of the same railroad. The northerly end of the line is about 1½ miles east of the Cold Spring station on the Hudson River division of the New York Central R. R.

The portion of the Catskill aqueduct to be built under this first contract is nearly eleven miles long. This is equivalent to about one-third the length of either of the Croton aqueducts and nearly equal to the full length of either of the large aqueducts recently built for the Boston Metropolitan Water-Works. The capacity of the Catskill aqueduct, however, will be 500,000,000 gals. daily, while that of the other aqueducts named, excepting the old Croton, is 300,000,000 gals. per day.

The great amount of work, including surveys, borings and test pits, preliminary to the designing and locating of so large a project as even one division of this aqueduct has been completed in record time, and the drawings and specifications are so well advanced that the Commissioners of the Board of Water Supply expect to advertise the work about the first of November, in order that bids may be received shortly after the middle of November. Some intending bidders are already looking over the ground and familiarizing themselves with the location and conditions of the work in advance of the formal advertisement for bids, so that they will be prepared to complete their estimate and bid when the advertisement appears.

The work is of considerable magnitude, but it is important that it should be done in as short time as is feasible. This will require ample and well organized plants and forces. Improved methods and appliances for securing speed and excellence in the performance of the work will be encouraged.

The Board of Water Supply consists of Mr. J. Edward Simmons, President; Mr. Charles N. Chadwick and Mr. Charles A. Shaw, with Mr. Thomas Hassett as Secretary. Mr. J. Waldo Smith is Chief Engineer, and Mr. Alfred D. Flinn is Department Engineer of the Headquarters Department, with offices at 299 Broadway, New York City. Mr. Robert Ridgway, 42 Market St., Poughkeepsie, N. Y., is Department Engineer of the Northern Aqueduct Department, in which department the work about to be advertised is located, and Mr. A. A. Sproul, 21 Nelson Ave., Peekskill, N. Y., is the Division Engineer under whose immediate supervision this work will be carried on.

It is expected that pamphlets containing information for bidders, specifications, and forms for contract, proposal and bonds, together with lithographs of the contract drawings, will be ready for distribution to intending *bidders* during the first week of November. Further information can be obtained at the offices mentioned. Additional details will be given in the official advertisement, which, it is anticipated, will appear in this journal and certain daily papers in the near future. Contracts for other large portions of the work are in course of preparation and will probably be advertised during the winter.

*A statement issued by the Engineering Department of the Board of Water Supply, City of New York (299 Broadway).

THE SOUTHERN STORM LOSS to the Florida East Coast Ry. was comparatively light so far as damage to the line of road under construction is concerned. According to a despatch dated Oct. 22, from St. Augustine, Fla., from Vice-President J. R. Parrott to President H. M. Flagler, 26 Broadway, New York, all finished piers and equipment at Key West are safe; the partly finished work, however, is gone. The water did not go across the finished grade at any point. Some exposed [illegible] embankment was slightly damaged, and the earth [illegible] bankment was badly washed in places. At Big Pine K[illegible] the water tanks and excavator are intact, but [illegible] tentage and supplies are all gone. Several lighters [illegible] sunk at Knights Key, but most of the cargo was sa[illegible] At Long Key the entire equipment is gone except [illegible] excavator, one barge, a steam lighter stout, one quar[illegible] boat and one launch. At Lower Matecumbe 45 men [illegible] missing from two house-boats used for caring for dr[illegible] crews. Three house-boats and three dredges were sli[illegible] damaged, but the crews were saved. A pile driver, [illegible] ever, was lost with two men aboard. Besides 20 [illegible] lost on the "St. Lucie," there are 146 missing. A [illegible] terboat with 104 men aboard broke up after cr[illegible] the outer reef at Long Key. Of these, Engineer [illegible] berry and 48 men were picked up by an Italian st[illegible] and carried to Key West; in addition, 23 men fr[illegible] quarterboat were later brought into port.

A CYCLONIC STORM, which swept over Cuba O[illegible] reached as far north as the Carolinas, doing great [illegible] age, especially on the East Coast of Florida. The p[illegible] erty loss at Havana, Cuba, is estimated at $2,000,[illegible] while some 20 Cubans were killed. Ten barge[illegible] carrying 150 men employed by the Florida East Coa[illegible] on its extension from Miami to Key West, Fla., [illegible] carried out to sea, and up to the present time only [illegible] of these laborers have been accounted for.

THE SEVERE GULF STORM of Sept. 26 and 27 [illegible] injured or destroyed about 60 light stations of the U. S. Light House Service. Most of these were beacons founded on clusters of piles and marking the ship channel in Mobile Bay. The upper part of the beacon was covered with slats and painted to serve as a prominent mark in daylight. Their destruction was doubtless due to the large surface exposed to wind pressure. The most important structure affected was the light house on Sand Island, Ala. This is a circular brick structure with a lantern 126 ft. above the ground at the base, and 2[illegible] ft. above high-water mark. The tower was founded on a block of concrete about 40 ft. in diameter, resting on piles. Sand Island itself was washed away, the keeper's dwelling adjacent to the light house was destroyed and the keeper and his family were lost. The tower itself still stands, although the light was extinguished. On Horn Island, near the entrance to Mississippi Sound, stood a light keeper's house 25 ft. square, surmounted by a lantern 31 ft. high. The ground where the house stood was about 10 ft. above high-water. Where this house stood there is now a channel. The keeper and his family perished.

A FRENCH SUBMARINE BOAT SANK off Bizerta, Tunis, Oct. 16, from unknown causes. The submarine, the "Lutin," was carrying on plunging experiments and failed to come to the surface after a submersion. When found she lay at a depth of 118 ft., and, according to reports of divers, the hood of her coning tower was open, and the hull full of water. The "Lutin" was a single-screw boat, 135 ft. long and 9 ft. 6 ins. in diameter, having a displacement of 185 tons. At the time of the accident she carried a crew of 14 men and 2 officers.

A MINE EXPLOSION at the Wingate colliery, near Durham, England, Oct. 15, entombed 200 miners, 27 of whom were dead when found. The remaining entombed men were rescued alive. The explosion is thought to have been due to fire damp.

A RUNAWAY CAR, on the Brooklyn Avenue Line of the Interurban Electric Railway Co., of Los Angeles, Cal., Oct. 13, resulted in the death of one person and the injury of nineteen others, three fatally. The accident was due to defective brakes, neither the air nor hand brakes being in working order. The car rushed down a steep grade, jumped the track at a sharp turn at the bottom and crashed into a telegraph pole, killing and injuring the passengers as it turned over.

THE FEDERAL EIGHT-HOUR LAW was declared violated by a decision handed down on Oct. 18 by a jury in the U. S. District Court at Boston. The case was brought against Mr. William H. Ellis, a Boston contractor, who, the Government contended, had worked his men more than eight hours. The defendant admitted that the men had been worked over-time, but urged that it was done in a case of emergency. Judge Dodge, before whom the trial was held, virtually instructed the jury to bring in a verdict of guilty, if it was satisfied that the representations made by the prosecution were facts. At the request of U. S. Attorney French, Judge Dodge defined an extraordinary emergency as follows:

An extraordinary emergency is the sudden, unexpected happening of something not of the usual, customary or regular kind, demanding prompt action to avert imminent danger to life, limb, health or property. The possibility of danger is not enough. The peril must be sudden, un-

unusual imminent and actual in order to constitute an extraordinary emergency.

The attorney for the defense was Mr. Boyd B. Jones. It is understood that the case will be carried up to the highest court.

PNEUMATIC SHAFT-SINKING will be resorted to at [illegible], Minn., to get down two mine-shafts on property of Pickands, Mather & Co., of Duluth, Minn. The contractors have been at work on the two shafts, the Syracuse and the Bangor, for a considerable time, and have encountered so many difficulties that they recently gave up their efforts and engaged The Foundation Company, of New York, N. Y., to do the work by the pneumatic process. In the Syracuse shaft bed-rock will be found at [illegible] ft., while the groundwater level is at 52 ft. In the Bangor shaft water will be met at 45 ft. and rock at 150 ft. Both shafts will be lined with reinforced concrete.

SEWAGE CONTACT BEDS, to provide at one and the same time purification and storage for discharge of effluent into tide-water on the outgoing tide, were suggested by Mr. E. Bailey Denton, M. Inst. C. E., in a recent address in Great Britain. Mr. Denton proposed ordinary screening, followed by a second screening by passing sewage upwards through broken stone, as preliminaries to "storing the resultant liquid in, comparatively speaking, fine contact beds until the period for its liberation arrives." Mr. Denton will be remembered by some of our readers as one of the apostles of intermittent filtration as it was understood many years ago in England. He is still a believer in treatment of sewage on land, either by intermittent filtration or broad irrigation or both, according to local circumstances, wherever feasible.

WATER SUPPLY AND FIRE PROTECTION AT INdianapolis has been reported on by the Committee on Fire Prevention of the National Board of Fire Underwriters (135 William St., New York City). The water supply is described as adequate and generally satisfactory, but the consumption is held to be "rather large" and the main and secondary feeder pipes "too widely spaced in most sections outside the congested value district." Some of the minor piping is also thought to be too small, the gate valves and hydrants too widely spaced, and a number of the hydrants of an unsatisfactory type. The fire department as a whole is "efficient, although undermanned," but it has a limited financial support and politics affect the tenure of office of the force. The prevailing structural weakness, combined with the frequency of conflagration breeders and other defects, gives a severe conflagration hazard in most of the blocks in the congested value district; but this is "mitigated by the good width of streets, adequate water supply, good pressure, efficient fire department, and fairly reliable fire alarm system."

A LARGE IRRIGATION RESERVOIR is projected for construction near Platteville, Colo., on the South Platte River, about 40 miles north of Denver. The project has been recorded in the office of Mr. T. W. Jaycox, State Engineer, by Mr. Frank J. Macarthy, of the Majestic Building, Denver, as claimant and engineer, under the name of the "Wild Cat Reservoir." The proposal is to form a large irrigation district and to build by degrees a dam and reservoir with a storage capacity of 500 000 acre-feet, covering at 80 ft. elevation an area of about 25 sq. miles. This reservoir would impound flood waters of the Platte River and tributaries and also water from Big and Little Thompson Creeks diverted by canals. The drainage area tributary to the reservoir would be about 7,000 sq. miles at an elevation of 12,000 to 14,000 ft. above sea level.

THE THIRD REPORT OF THE ONTARIO HYDRO-Electric Power Commission dealing with the Lake Huron and Georgian Bay district has just been issued. According to the commissioners there is a total demand there for 16,000 HP. A considerable proportion of this power can be supplied locally or by transmission systems already constructed. In some small scattered towns at a distance from water powers, however, there does not appear to be any opportunity to meet the small possible demands. Aside from these, the power market amounts to about 12,800 HP. On the other hand, there are many undeveloped locations of considerable magnitude, for whose power there is at present no near market; these are located on the Moon, Muskoka, Magnetawan, French and Wahnapitae Rivers. The natural uses to which these powers might some day be devoted would be pulp-grinding, wood-working manufactures, or ultimately the operating of railways now operated by steam. As in the thickly-settled portions of the district covered by the report, water powers are scarce and limited, and valuable, and as a demand exists now for all the power which can be conveniently produced, it therefore is imperative that the water powers of the Severn, Muskoka, or other rivers not yet leased by the Crown be retained for the use of the many municipalities which must for all time depend on these sources for whatever electrical energy they may obtain from water power. In case any lease of water power be granted in the future, such lease should specify the rates at which the Hydro-Electric Power Commission may obtain electric power in a condition for transmission, or at the points of delivery in the various municipalities. According to the commissioners the cost of 24 HP.-hr. per year at the following towns would be: Goderich, $16.04; Clinton, $22.08; Seaforth, $21.03; Mitchell, $26.47; Port Elgin, $20.26; North Bay, $28.35; Powassan, $24.89; Berlin, $17.36; Elmira, $24.10; Elora, $26.56; Fergus, $29.91; Newmarket, $20.94; Aurora, $22.74; Bond Lake, $20.34.

THE STRENGTH OF GREEN TAMARACK AND green Norway pine timber has recently been tested by the Forest Service of the U. S. Department of Agriculture, at the timber testing laboratory of Purdue University, Lafayette, Ind. Nearly all of the material tested grew in St. Louis County, Minn.; the strength values obtained for it apply only approximately to the same species grown elsewhere. The bending tests were made upon timbers having cross-sections of 4 × 10 to 6 × 12 ins., with a span of 13 ft. 6 ins. between supports. The results were as follows:

Strength, Modulus of Rupture.

Tamarack	4,600 lbs. per sq. in.
Norway pine	4,000 lbs. per sq. in.

Stiffness, Modulus of Elasticity.

Tamarack	1,240,000 lbs. per sq. in.
Norway pine	1,189,000 lbs. per sq. in.

Tamarack is usually a slower grower than the pine, and tests on small clear pieces indicated that the strength of tamarack decreases if the rate of growth is more than an inch in 8 years, while Norway pine is similarly affected when the growth is faster than an inch in 10 years. The weight of oven-dryed tamarack is 29 lbs. per cu. ft., Norway pine, 24 lbs. per cu. ft. Tests on seasoned timber of these species will be made later.

PIG-IRON PRODUCTION has decreased enormously of late owing to the high prices asked for coke. Although the coke ovens of Connellsville are turning out large quantities, the demand is far greater than the supply. Foundry coke is now selling for $3.60 to $3.75 per ton, and within a few weeks it will probably be raised to $4 per ton. The shortage of cars is said to be partly responsible, it being more difficult each week to get the coke delivered. The price of bar iron has, in consequence, been raised $2 per ton, and the prospects are that before the winter is over it will reach $5 per ton. As the demand for pig iron is greater than ever before in the history of the steel trade, the scarcity is a serious matter. The outputs of many furnaces have been oversold for 1906 and of several of them for the first six months of 1907. All such sales have been made at high prices. In this connection it is interesting to note that the western and southern rail mills have sold their entire rail output for 1907; the eastern mills about six months of their output; and the Pittsburg mills cannot accept contracts for delivery during the first four months of 1907. The steel plate mills have nearly all the orders they can handle through the first quarter of next year, and the sheet and tin plate mills have sold almost their entire output for 1906.

THE RELATIVE COST OF CONTACT BEDS AND percolating filters for the treatment of sewage is briefly discussed in a paper on "Sewage Disposal at Manchester and Birmingham," by Prof. L. P. Kinnicutt, of Worcester, Mass., published in the "Journal of the Association of Engineering Societies" for March, 1906. The comparison relates to England and is based on figures for contact beds at Manchester given by Dr. Gilbert J. Fowler, and percolating filters at Birmingham given by Mr. John D. Watson. We quote from Professor Kinnicutt's paper, as follows:

Original cost of well constructed contact beds, filling material, graded furnace clinker, $13,000 per acre. Original cost of equally well constructed percolating filters, filling material, crushed stone, fist size, $30,000. Amount of sewage that can be satisfactorily treated by contact beds, 400,000 Imp. or 478,000 U. S. gals. per acre per day. Amount that can be treated by percolating filters, 750 000 Imp. or 896,400 U. S. gals.

Cost, calculated per unit capable of treating 1,000,000 U. S. gals. daily, contact beds, $27,196; percolating filters, $33,470. Dr. Fowler's figures are, however, for contact beds filled with furnace clinker; Mr. Watson's for percolating beds filled with broken stone, and even if the life of the percolating filter is no longer than that of the contact bed, the material lost in washing and sifting when the beds are reconstructed must be much greater with furnace clinker than with broken stone.

The original cost of the clinker used in the Manchester filters was 87 cts. per cu. yd. After this had been used for some four years, it was necessary to remove the clinker and wash it. This work cost 31 cts. per cu. yd. when all the material was taken out, and 41 cts. for that portion, only, that was "badly broken down and clogged." The replacement of lost material cost about 31 cts. per cu. yd., making a total of 72 cts. for removing, washing, sifting and replacing the material, or 71% of the original cost of the material in place. The washed material, however, was of far better character than the original, as the softer portions were of course rejected by the washer. The total cost of the broken stone used in the percolating filters at Manchester was $1.60 per cu. yd., of which $1.48 was for the stone delivered at the site of the sewage works and 12 cts. for handling and placing it there.

SOME UNUSUAL QUALIFICATIONS OF AN ENGIneer are set forth in a paper by Mr. Edward Dobson, M. Inst. C. E., of New Zealand. The paper is one just issued by the Institution of Civil Engineers, and gives reminiscences of early engineering work in Australasia, whither Mr. Dobson emigrated from England 56 years ago. One of his earliest tasks was the location of a bridle path through a dense thicket, and he says concerning it:

The cutting of the Akaroa bridle path was the author's introduction to tent life, and the first of a long series of experiences, from which he learned a few of those lessons which are an essential part of the education of an engineer, but which he is not taught either at school or at college. He should be a good shot and a good cook, and be able to make and mend his own tents if necessity arise. He must be able not only to swing an axe, but to carve the delicate curves of an axe-handle with no other tools than a spoke-shave and a piece of broken glass for a scraper. Axe-handles, unless made of well-selected material, often come to grief, and the cutting of axe-handles is a useful amusement when sitting round the camp fire in the evenings. This catalogue of qualifications might be extended ad infinitum, and it goes without saying that he should be able to ride and drive, and manage a boat; but he should also be able to shoe his pack-horses, repair their harness, and use the diamond-hitch in securing their loads, which, in the author's opinion, is the best precaution against strain and sore backs. Again, accidents are sure to happen sooner or later, and it is well that the leader of a party should understand ambulance work, and know how to set a broken limb and how to bandage a cut or a strain.

MUNICIPAL OWNERSHIP at Port Arthur, Ont., is practiced to an unusual extent for a municipality this side of the Atlantic. It includes water, telephone, street railway and lighting plants. Reports that have reached us state that the net earnings of the various systems are taking care of the total bonded indebtedness, and that notwithstanding the fact that a large amount of public work has been done recently the general tax rate is only nine mills on the dollar.

THE BELLE FOURCHE IRRIGATION PROJECT in South Dakota, (Engineering News, Feb. 22, 1906,) is progressing so satisfactorily that it is believed water can be delivered to about 10,000 acres of land next season. The contractors are having great difficulty in securing workmen, having to bring them in continually from Omaha, Denver and other labor centers. Contractors are paying from $2.50 to $2.75 per day for common laborers, and the government is paying $2.20 per eight-hour day.

SULPHUR AND SAND for jointing vitrified sewer pipes was extensively used on a joint sewerage system for towns and municipalities in eastern New Jersey a few years ago, as was described at length in an article by Mr. Alexander Potter, engineer for the system, in our issue of March 10, 1904. During the past two years, we are informed, this material has been used on some forty miles of sewers in Newark, Orange, Montclair, Lakewood and other New Jersey towns, being employed on sewers ranging from 8 to 22 ins. in diameter. The material on this later work was supplied, ready for heating and melting, by Mr. F. H. Pough, 28 Burling Slip, New York City, under the trade name of "Pozite." The material is shipped in barrels or boxes as "a fine, dry powder," the sulphur and sand being mixed in the proper proportions to melt readily and to develop a tensile strength of about 300 lbs. per sq. in. As stated in Mr. Potter's article, mentioned above, water need be kept from joints formed by this material only long enough to pour the joints. In a circular issued by Mr. Pough it is stated that "the joints should first be thoroughly calked with jute packing well rammed down. Any form of joint runner is then fastened around the pipe, closing the mouth of the bell," after which the melted jointing material is poured, in the same way as lead for jointing cast-iron pipe. To prevent adhesion of the cement to the joint runner, the latter should be damp before the jointing material is poured, "and a little moist clay should be used to prevent overflow at the top of joint." Pipes up to 10 or 12 ins. in size may conveniently be joined in two or three lengths on a cradle at the surface and lowered into the trench, thus saving jointing in the latter position. The sections thus jointed may be safely lowered within a few minutes after pouring. The circular indicates, and Mr. Potter's article emphasizes, the need of providing a firm support for the pipes, so as to guard against settlement, since the sulphur and sand joints are quite rigid. It will, of course, be understood that one of the chief objects of using this jointing material is to prevent infiltration of ground water; besides this, it is stated that

fewer roots gain access to sewers where this jointing material is used than where ordinary cement joints are made. In this connection it may be of service to some of our readers to know that there were some interesting discussions of the infiltration of ground water into sewers in our issues of Aug. 27, Oct. 8 and 29, 1903. In the two last-named numbers, facts were given regarding the use of cement and pitch-pine tar on vitrified pipe for water-works purposes at Atlantic City, N. J.

TESTS OF THE HOLDING POWER OF TRACK SPIKES have recently been made by the Forest Service of the U. S. Department of Agriculture. The tests were made on ordinary commercial ties of loblolly pine, oak, chestnut, and other woods. The spikes used were of four kinds: Common driven spikes, a driven spike which has about the same form as the common spike with a longitudinal channel on the side away from the rail; screw spikes of the American type, and screw spikes similar to those in use on European railroads, and differing from the American spike mainly in the manner of finishing the thread under the head. The common and the channeled spikes were driven into the ties in the usual manner to a depth of 5 ins. A hole of the same diameter as the spike at the base of the thread was bored for the screw spikes, which were then screwed down to the same depth as the driven spikes. The spikes were then placed in the testing machine, and the force required to pull each spike was recorded. The average force required to pull common spikes varies from 7,000 lbs. in white oak, to 3,000 lbs. in loblolly pine, and 3,000 lbs. in chestnut. The holding power of the channeled spike is somewhat greater. For example, about 11% more force, or 4,000 lbs., is required to pull it from the loblolly pine tie. The two forms of screw spikes have each about the same holding power, ranging from 13,000 lbs. in white oak to 9,400 lbs. in chestnut, and 7,700 lbs. in loblolly pine.

AMERICAN BOLTS AND NUTS are not giving satisfaction in Australia, according to consular reports, the English thread (Whitworth) being preferred to the U. S. standard. Complaint is also made that the fitting of nut and bolt is not as tight as in the English product.

GOLD DREDGING BY ELECTRIC POWER is of common occurrence in the West, particularly where cheap power can be obtained from hydro-electric stations. With current selling at about 1 ct. per KW.-hr. the cost of operation, including power, repairs, maintenance, and labor, averages 5 cts. per cu. yd. of gold-bearing soil handled. This low cost of operation results in a large measure from the dredges being operated nearly 90% of the possible running time. The remaining 10% is taken up by stoppages due to lack of power, cleaning, and repairs. In some of these dredges the gold-bearing soil is lifted by electrically-driven centrifugal pumps, and in others endless chains with buckets are used. Between 40,000 and 80,000 cu. yds. of earth are handled per month per dredge. Owing to the considerable distance over which the power must generally be transmitted from the generating station, high-tension alternating current is used. This is stepped down by transformers mounted in some cases on the dredges and in others on poles on the shore. A half dozen or more motors are required on the dredge for the various operations and these are usually of the three-phase induction type ranging in size from 15 to 50-HP.

INDUCTION MOTORS have recently been put to varied uses in the making of linseed oil and coke from the raw material, by the Archer Daniels Linseed Co., of Minneapolis, Minn. The raw material, flax-seed, is elevated by a 30-HP. induction motor to the cleaning room. Here the seed is freed from dust and dirt by motor-driven fans, the refuse being sucked up and carried to the waste-bins by exhaust fans, also motor driven. The flax-seed then goes to the grinding mill which is operated by a 60-HP., 2,300-volt induction motor, and the seed is reduced to meal. After the meal has been cooked about an hour and a half, oil is applied to it by hydraulic presses, the pumps for the presses being driven by induction motors. Induction motors are also used in pumping the oil from the presses to the vats, where it is filtered, and afterward in pumping it to the storage tanks. The complete electrical equipment of this plant was furnished by the General Electric Co., of Schenectady, N. Y. The motors are of the three-phase type, and all of 35 HP. and over are operated directly at 2,300 volts. For the smaller motors the 2,300 volts is stepped down to 220 volts by 56-KW., three-phase transformers.

PERSONALS.

Mr. Mason R. Strong, Engineer of Bridges and Buildings of the Erie R. R., has resigned.

Mr. Edward H. Rockwell, Assistant Professor of Civil Engineering, Tufts College, has been appointed Professor of Structural Engineering of that institution.

Mr. Stacy W. Kapp, Division Engineer of the New Jersey & Lehigh Division of the Lehigh Valley R. R., has resigned to accept a position with the Maryland Steel Co., Sparrows Point, Md.

Mr. Herbert Wilgus, Engineer of the Brooklyn Rapid Transit Co., has been appointed Engineer of Maintenance of Way of the Pittsburgh, Shawmut & Northern R. R., to succeed Mr. A. G. McComb.

Mr. Foster Crowell, M. Am. Soc. E. E., Consulting Engineer, 18 Broadway, New York City, has been appointed Chief Consulting Engineer to the New Jersey Terminal, Dock & Improvement Co.

Mr. Stone Edelen has resigned his position on the engineering staff of the McClintic-Marshall Construction Co. of Pittsburg, Pa., to accept a similar position with the Locomotive and Machine Co., Ltd., of Montreal.

Mr. A. N. Leitnaker has been appointed General Superintendent of the Jonesboro, Lake City & Eastern R. R., in charge of the Transportation, Mechanical and Maintenance of Way Departments. His headquarters are at Jonesboro, Ark.

Mr. Eugene N. Hunting, formerly Engineer for the Cummings Structural Concrete Co. of Pittsburg, Pa., has accepted the position of Engineer in the Reinforced Concrete Department of the General Fireproofing Co. of Youngstown, Ohio.

Prof. Palmer C. Ricketts, Director of Rensselaer Polytechnic Institute, has returned to Troy, N. Y., after an absence abroad of over a year. The trip was made necessary by ill health, but he is now sufficiently improved to resume his duties.

Mr. Max E. Schmidt, General Manager and Chief Engineer of the Continuous Transit Securities Co. of New York City, has been awarded the John Scott Legacy Premium and Medal, by the Franklin Institute of Philadelphia, Pa. The award was made for improvements in moving platforms, for the transportation of people in large cities.

Mr. Francis L. Pruyn, a member of the firm of United Engineering & Contracting Co., has withdrawn from this company and formed a partnership with Mr. Joseph Caccavajo, under the name of Caccavajo & Pruyn, Consulting Engineers, 55 West 33d St., New York City. They will make a specialty of buildings, foundations, subway and tunnel construction.

Mr. F. C. Finkle, Chief Engineer of the Edison Electric Co., of Los Angeles, Cal., has handed in his resignation, to take effect Jan. 1, 1907. He will open an office at Los Angeles as a consulting engineer, giving special attention to hydro-electric power development. As Chief Engineer of the Edison Company, Mr. Finkle has had charge of the construction of the seven hydro-electric plants, which that company has built in Southern California in the last eight years.

Mr. Macdonough Craven has been appointed, by Mayor McClellan, Commissioner of the Street Cleaning Department of New York City, to succeed Major John McGaw Woodbury, resigned. Mr. Craven is a graduate of the Annapolis Naval Academy, class of 1881, and has been connected with the street cleaning department for ten or a dozen years. He investigated and reported on garbage disposal by reduction for the late Col. Geo. E. Waring, when the latter was Commissioner of Street Cleaning of New York City, and has been engineering inspector in behalf of the city, at the Barren Island garbage reduction works, since their construction, nearly ten years ago.

The contract for the construction of the Panama Canal, on which bids are to be received on Dec. 12, was drafted by the General Counsel of the Isthmian Canal Commission, Mr. Richard Reid Rogers. Mr. Rogers is a native of Kentucky and a graduate of Princeton University and of the law school at the University of Virginia. He practiced law in Louisville for several years and was for 2½ years assistant to the Attorney-General of Kentucky. In recent years he has been associated with the law firm of Guthrie, Cravath & Henderson, in New York City. He was appointed General Counsel to the Isthmian Canal Commission, with headquarters in Washington, at a salary of $10,000 per year, on July 1 last. The Panama Canal contract was drafted by Mr. Rogers after long consultation with Secretary Taft and Chairman Shonts, and with the advise of several contractors of long experience.

Obituary.

Henry C. Roney, a bridge contractor of Indianapolis, Ind., died in that city, Oct. 12, of apoplexy.

Frederick Corse Wheeler, a civil engineer, formerly of Brooklyn, N. Y., died at Helena, Mont., Oct. 19.

Thomas M. Cunningham, of Savannah, Ga., Treasurer of the Central of Georgia Ry., died at New York City Oct. 12.

Frank Waller, Assistant Manager of the Hodge Electrical Co. of Kansas City, Mo., died in that city, Oct. 9, aged 26 years.

James Ferguson, a contractor and builder, formerly associated with the Ferguson-Miller Construction Co. of New York City, died Oct. 21, of apoplexy, aged 64 years.

Richard Esterbrook, a retired architect of New Orleans, La., died in that city, Oct. 16, aged 93 years. He was the architect for the State House of Louisiana, the City Hall and other important buildings of New Orleans.

Benjamin Howard Warren, M. Am. Soc. M. E., of New York City, died Oct. 21, at Hotel Collingwood, of cerebral apoplexy, aged 57 years. Mr. Warren was widely known in the engineering profession from his connection with the Westinghouse and Allis-Chalmers companies. He was for many years an engineer officer in the U. S. Navy, and later became connected with the Pratt & Whitney Co. of Hartford, Conn. In the '90's he went to the Westinghouse Electric Co. as Vice-President, and held that position many years. In 1904-5 he was President of the Allis-Chalmers Co. On his retirement from that position he opened an office in New York City as Consulting Engineer with Mr. Asa M. Mattice. Mr. Warren had served as a Vice-President of the American Society of Mechanical Engineers, and was a member of the Engineers' Club of New York City. His home was at Alberene, Va.

ENGINEERING SOCIETIES.

COMING MEETINGS.

ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA.
Nov. 13-15. Annual Meeting at Chicago, Ill. Secy., C. E. Jones, Beardstown, Ill.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS.
Dec. 3-4. Annual Meeting at New York City. Secy., W. Everett Parsons, 12 Bridge St., New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 4-7. Annual Meeting at New York City. Secy., F. R. Hutton, 12 West 31st St., New York, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Dec 27-Jan. 2, '07. Annual Meeting at New York City. Secy., L. O. Howard, Cosmos Club, Washington, D. C.

THE RAILWAY SIGNAL ASSOCIATION.—At the annual meeting of the Association, held at Washington, D. C., Oct. 16-18, the following officers were elected for the year 1906-7: President, Mr. J. A. Peabody; Senior Vice-President, Mr. A. H. Rudd; Junior Vice-President, Mr. L. R. Clausen; Secretary and Treasurer, Mr. C. C. Rosenburg.

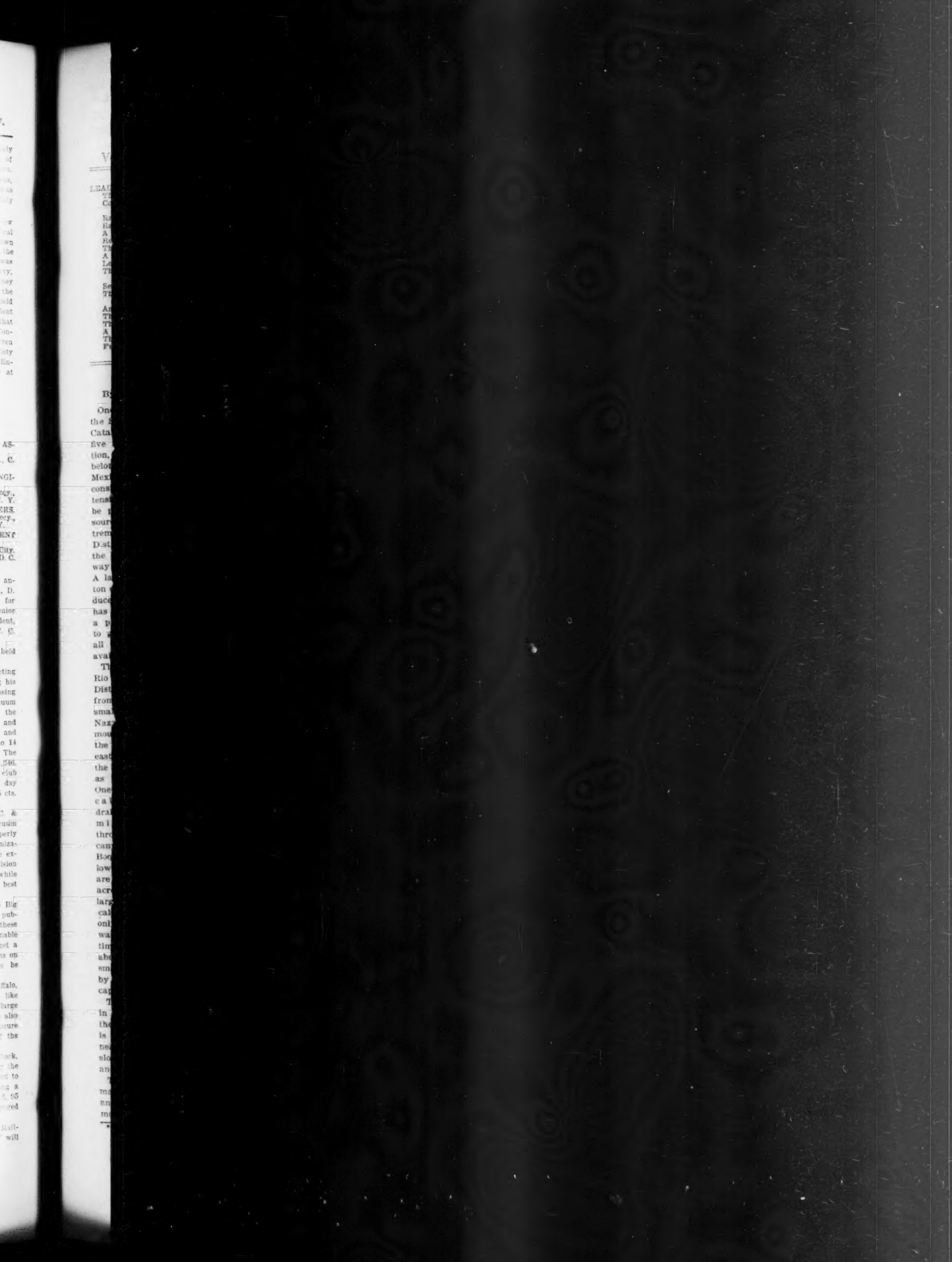
The next annual meeting of the Association will be held at Milwaukee, Wis., Oct. 8, 1907.

NEW YORK RAILROAD CLUB.—The October meeting of the club was opened by Mr. B. P. Flory reading his paper on "Car Cleaning." The paper, besides discussing car cleaning in general, described the $18,000 vacuum plant of the Central Railroad of New Jersey, at the Jersey City, N. J., terminal, for cleaning both cars and station. Two 40-HP. steam pumps drive the plant, and give a vacuum in the separators ranging from 29 to 14 ins., according to the number of nozzles open. The number of cars cleaned at this plant per month is 1,346, which includes Pullmans, day coaches, dining cars, club cars, private cars, etc. The cost of cleaning a 60-ft. day coach with this system is about 25 cts., as against 45 cts. when compressed air is used.

Mr. H. M. Butts (Master Car Painter, N. Y. C. & H. R. R. R.) expressed the opinion that both the vacuum and compressed air system should be used to properly clean a car, and that much also depended on organization. He placed the average life of varnish on the exterior of cars at one year, and recommended oil emulsion as a cleaner, as it prolongs the life of the varnish, while for the interior he thought a neutral soap was the best cleanser.

Mr. J. A. Cohen (formerly Master Painter of the Big Four) said that all first-class roads to-day give the public comparatively clean cars to ride in, but that if these roads were to install the best cleaning plant obtainable with a well organized cleaning force they would get a much better return on their investment. The returns on the money expended under the present methods he thought average only about 60%.

Mr. W. J. Knox (Mechanical Engineer, Buffalo, Rochester & Pittsburg Ry.) thought that a plant like that described in Mr. Flory's paper would pay a large railroad to install, but hardly the smaller ones. He also thought that a compressed air system with low pressure and large volume of air would overcome many of the disadvantages of the present high pressure system.

Mr. F. W. Brazier (Superintendent of Rolling Stock, N. Y. C. & H. R. R. R.) said the cost of operating the vacuum plant described by Mr. Flory should be added to the cost of labor for cleaners. The cost of cleaning a car on the New York Central, complete, was, he said, 95 cts. The cost for the compressed air used averaged 15 cts. per car.

A paper by Mr. Robert Job on "Some Phases of Railway Practice, Showing Causes of Failures of Rails," will be read at the November meeting of the club.